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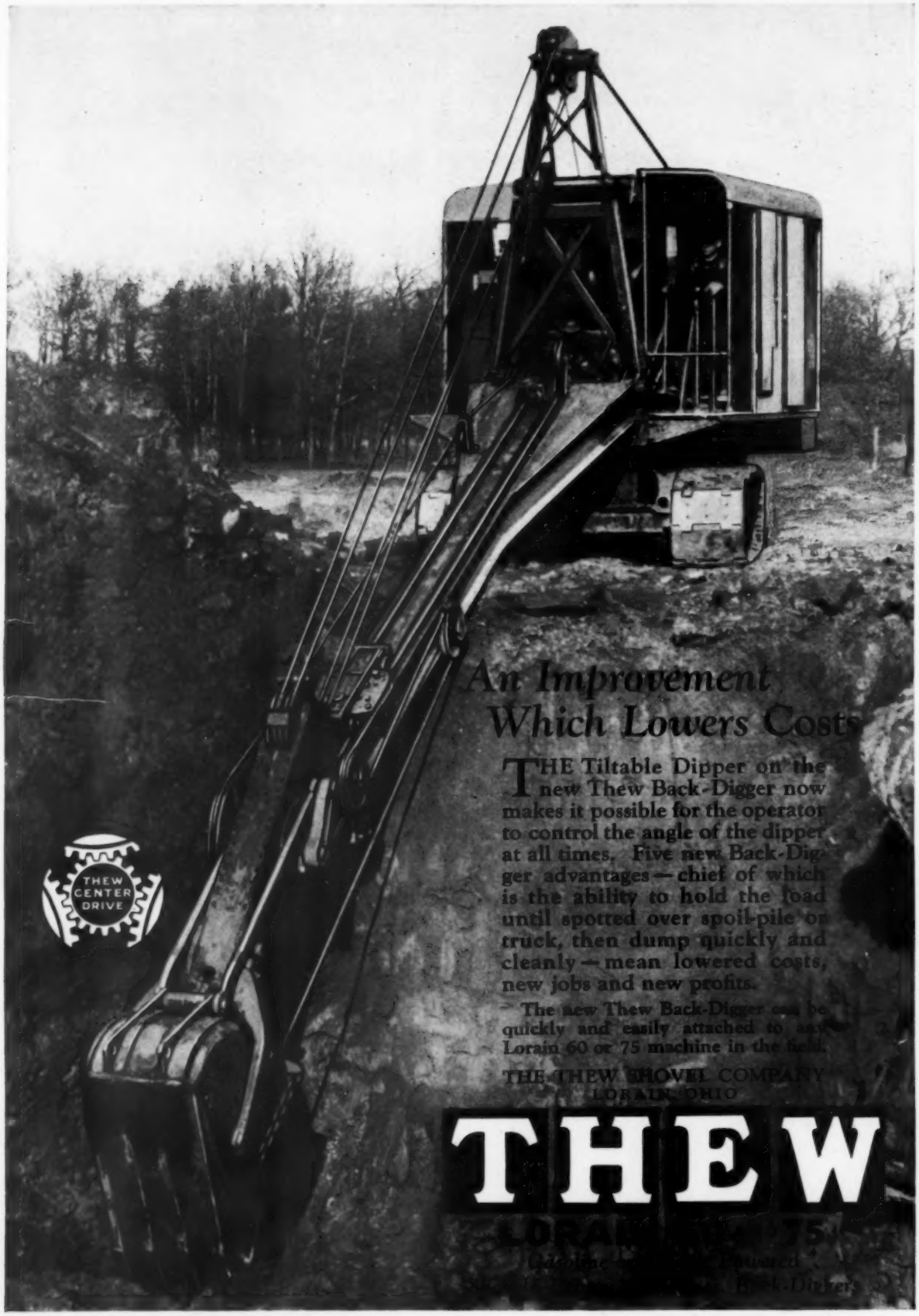

THEW
CENTER
DRIVE
An Improvement
Which Lowers Costs
THE Tiltable Dipper on the new Thew Back-Digger now makes it possible for the operator to control the angle of the dipper at all times. Five new Back-Digger advantages — chief of which is the ability to hold the load until spotted over spoil-pile or truck, then dump quickly and cleanly — mean lowered costs, new jobs and new profits.
The new Thew Back-Digger can be quickly and easily attached to any Lorain 60 or 75 machine in the field.
THE THEW SHOVEL COMPANY
LORAIN, OHIO
THEW

Please mention the CONTRACTORS AND ENGINEERS MONTHLY—it helps.

Volume XVI
Number 2

Contractors and Engineers Monthly

February, 1928

A Winter Job—83.4 Per Cent on Schedule

By James A. Burbank
Vice-President, John W. Ferguson Co.

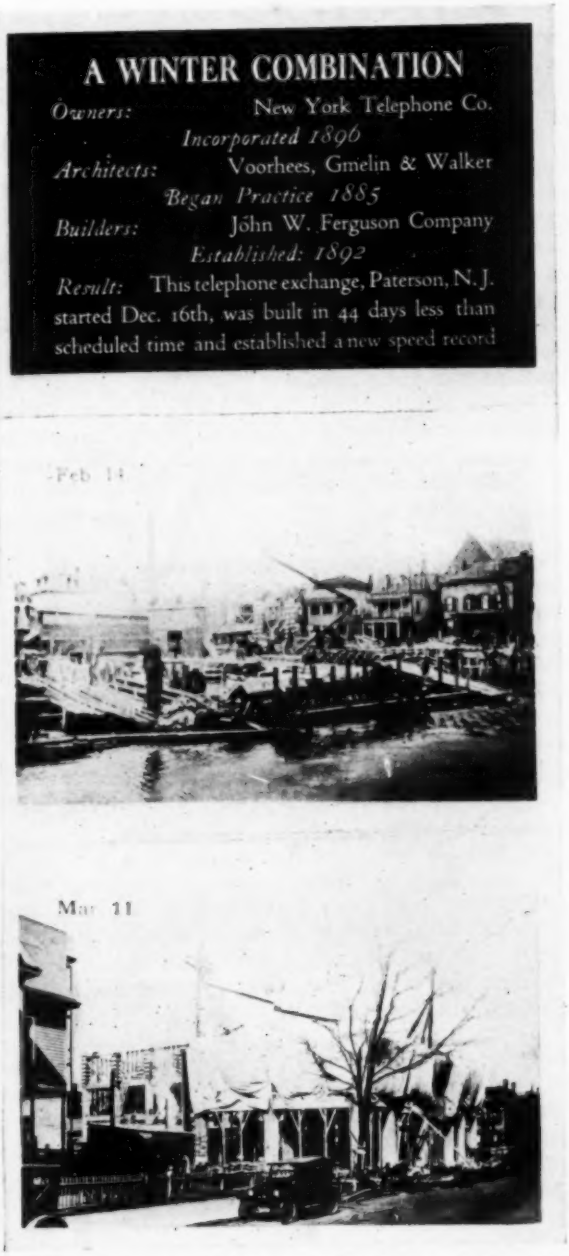
CAREFUL planning in every phase marked the work on the Paterson Street Telephone Exchange in Paterson, N. J., for the New York Telephone Co., which embodies all the modern features of telephone business and engineering practice. Commercial offices, switching rooms, storerooms, rest rooms, etc., are all housed under one roof in a structure built almost entirely of non-combustible materials.

With land and equipment included, the building project involved over a million dollars. Use of this

Author's Note

In preparing this brief story, I was at first tempted to stress the winter construction angle of the contract, which led me to look into our record and experience in winter work. I think that gathering our own figures made me realize more fully something that all contractors could realize to their advantage and profit. I found that we have been building in winter almost continuously since 1892, and have executed more than $20,000,000 worth of winter work. In other words, winter construction is not the unusual with us, but has taken its definite place in our yearly volume, with nearly one-third of our contracts involving construction during the severe winter months.

This leads me to observe that instead of talking winter construction as something that could be done or that ought to be done, let us all talk it on the far better ground of what has been done. Check over your own records and you will be surprised how much of your experience has involved winter construction. In that way we can get winter construction off the theoretical ground on to a practical ground and boost the volume of winter building.


A WINTER COMBINATION
Owners: New York Telephone Co.
Incorporated 1896
Architects: Voorhees, Gmelin & Walker
Began Practice 1885
Builders: John W. Ferguson Company
Established: 1892
Result: This telephone exchange, Paterson, N. J. started Dec. 16th, was built in 44 days less than scheduled time and established a new speed record
Feb 14
May 11

Portion of Photographic Folder, Published by the John W. Ferguson Co., Depicting Progress on the Paterson Telephone Exchange Described in This Article

Lower Portion of the John W. Ferguson Company's Photographic Folder

building to the company in terms of interest on the investment, therefore, meant at least $1,500 per week, not to mention the improved service to telephone users and the income therefrom. So speed in construction meant more than mere words in the contract.

PROGRESS CHART—A SCHEDULE ADHERED TO

As soon as the contract for this work was awarded to the John W. Ferguson Co., the proposed progress of the building was carefully mapped out. This planning was done in conference at which the superintendent, who was to run the work, sat in with the general superintendent, the chief engineer, the purchasing agent, the traffic department representative and the treasurer of the company. Starting and completing dates were arrived at for each division of the actual construction work. These dates were optimistic yet entirely possible. The progress chart finally agreed upon is shown herewith. While this planning was going on, the necessary orders for material and subcontracts were being negotiated as rapidly as circumstances permitted.

PLANT LAYOUT COMPACT

Excavating started December 16, 1926. Various arrangements of plant were considered. The usual wood tower and hoist was laid out, its cost estimated and the cost of operation figured. The cost of a steel tower, with its chute for placing concrete without rehandling, was estimated, and, also, the cost of a steel mast plant, chuting to floor hoppers and then wheeling the concrete into place.

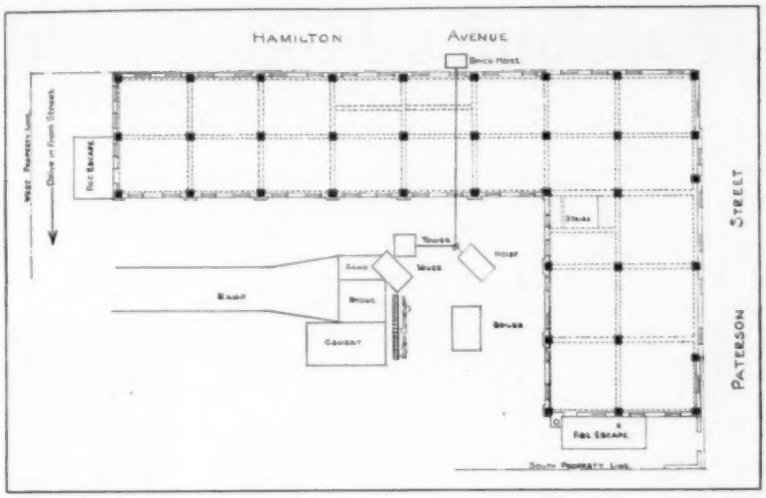
The steel mast plant installation was decided upon. Storage bins for sand and crushed stone were designed and built so that the bulk materials could be delivered by truck and dumped directly into the bin, the bin feeding by gravity into the hopper of the mixer. A total of 2,870 cubic yards of concrete was involved in this work, which warranted the expenditure of the necessary money on stone and sand bins, as against the alternative method of handling the aggregate by wheeling from stock piles on the ground.

To guard against freezing weather conditions during the construction of the building, a horizontal tubular boiler was installed close to the material bin. Steam jets were laid under the aggregate bins so that live steam could be fed into them. Steam from these jets would filter up through the crushed stone and sand, keeping the aggregate warm and free from ice. Enough steam was generated from this boiler to run the engine which drove the concrete mixer and, furthermore, live steam was available for use with nozzles on the floors for cleaning ice and snow from the forms and steel. With these facilities, plus the usual canvas enclosures and the salamanders, the work was not held up a single day by the weather.

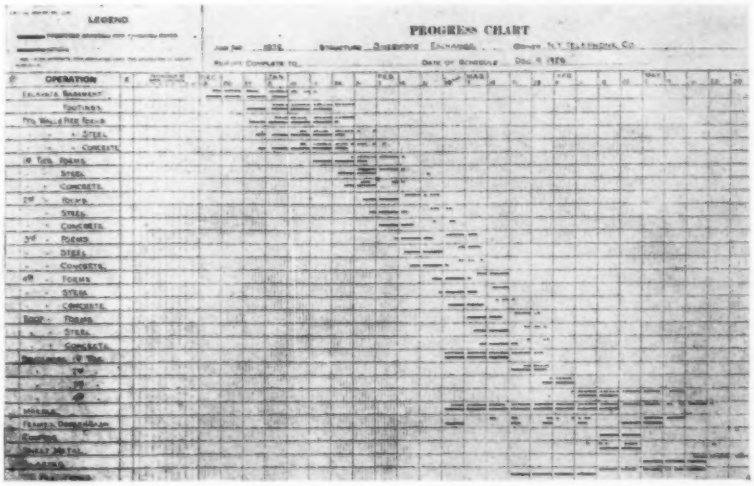
In order to maintain the progress schedule as laid out for this building, it was necessary to start the brick work before the roof concrete was entirely completed. Pole scaffolds and some hanging scaffolds were used. The brick hoist, as shown by one of the accompanying photographs, was placed outside the building, and served for both the exterior and interior brick and tile, thus permitting the elevator installation to proceed and avoiding the usual delay caused when this hoist is placed in the elevator shaft.

During the course of the actual construction of the building, the shops of the subcontractors were visited by representatives of our Expediting Department, and work in progress was checked up to make sure of the delivery dates of the required materials. Out of twenty-four subcontracts twenty began on time and finished on time. On the other four subs the delay did not exceed sixteen days.

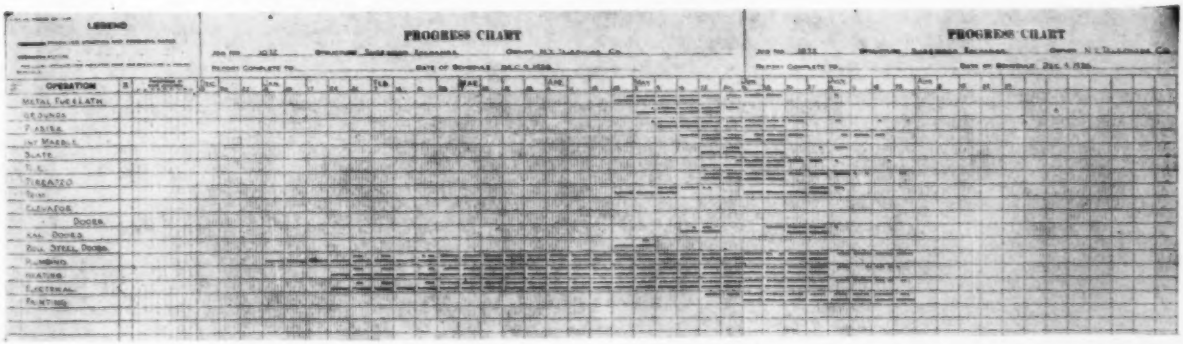
This contract brought together three organizations of considerable experience. The New York Telephone Co. was incorporated in 1896. The architectural firm of Voorhees, Gmelin & Walker dates back to 1885. The John W. Ferguson Co. was established in 1892. These



Layout of the Paterson Street Telephone Exchange Job, Showing Location of Sand and Stone Bins, Cement Shed, Roller Conveyor, Mixer Tower and Hoist



Progress Chart of the New York Telephone Co. Exchange at Paterson, N. J., Showing in Solid Lines the Predicted Starting and Finishing Dates and in Dotted Lines the Actual Startine and Finishing Dates



three experienced organizations, putting their heads together, clipped forty-four days off the contract schedule and established a new speed record in the construction of telephone exchanges.

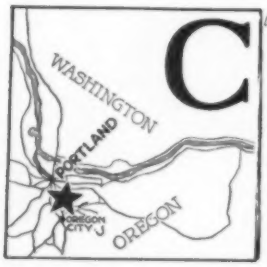
French Engineer Solves Novel Bridge Construction Problem

THE new bridge across the Sautet Gorge of the Drac River, in the French Alps, is to be a single reinforced concrete arch of 283 feet span, 525 feet above the bottom. The centering at such a height was a difficult problem, but it was solved by the engineer, Monsieur Caquot. According to *The Engineer* of London, of Dec. 23, 1927, p. 711, the solution was to span the gorge with a 3-hinged arch of wood construction, each half to be erected in a vertical position at either side and then rotated about the lower ends as pivots until the outer ends would meet in the middle, these two half-arches to be so shaped that, when in position, the upper chart would coincide with the curve of the intrados of the concrete arch, and thus act as a base for the forms. The construction of one of the abutments was completed not long ago, and very recently the placing of this unusual centering was successfully completed.

Portland's High Speed Boulevard

By George B. Herington

Executive Secretary, Portland Chapter, A. G. C. of A.



CANYON ROAD, one of the oldest thoroughfares into Portland, Ore., from the rich Tualatin Valley, enters the heart of Portland's west side through a long canyon and then crosses under an attractive arch bridge known as Vista Avenue Viaduct. The west side of Portland is the major business and high value section and is connected with the long, wide, crescent shaped area of its east side by seven bridges over the Willamette River. The old Canyon Road was one of the first improved roads in the vicinity of Portland. Lying low on the Canyon bed it was wet and slippery during the rainy season with flat and steep grades alternating and with many sharp curves, so that it presented difficulty in the fast driving of trucks or passenger cars.

Investigations

A tunnel through the ridge was first considered to bring the Tualatin district into closer access and some progress was made in planning it. In 1925, however, an investigation was made by the author of this article and a report made to a group of progressive business men. This report advocated a wide, high speed boulevard with corrected grades and easy curves to pass over the general Canyon Road site, thus making a high speed boulevard possible. It was shown that an extensive boulevard could be built and furnished with approaches for a lower first cost and at a minimum expense for maintenance as compared with a tunnel which would be competent to safely handle the available traffic which would await bettered highway facilities between the Valley and the city.

The county commissioners of Multnomah County and other authorities made further investigations and surveys under the direction of George W. Buck, Roadmaster of Multnomah County. The results led the commissioners to proceed vigorously on a large scale.

Marion Gas-Electric Shovel Equipped With Pit Lights for Night Operation

Bonds for this project and other better entrance facilities were voted by the community. Details of design for the Canyon Road were perfected and advertised on June 15, 1927. Wren and Greenough, experienced contractors, were the low bidders on the job.

Live Wires on the Canyon Road Project. From Right to Left, George W. Buck, Roadmaster, Multnomah County; K. C. Griffin, Sub-contractor; C. A. Toye, of H. J. Armstrong Company, and the Author

Quantities

The expected quantities of that portion of the whole highway for which Multnomah County assumed the cost and which are included in the Wren and Greenough contract, are listed below:

	Clearing and grubbing
238,000	yds. common excavation
24,000	yds. intermediate excavation
184,000	yds. rock excavation
2,550	yds. excavation for culverts
1,950	yds. rock excavation for culverts
1,000	yds. excavation for walls
1,200,000	sta. yds. overhaul
1,000	ft. 8-inch tile
10,500	ft. 8-inch concrete pipe
2,000	cu. yds. coarse gravel
2,600	ft. 12-inch concrete culvert
410	ft. 18-inch concrete culvert
500	ft. 24-inch reinforced culvert
570	ft. 30-inch reinforced culvert
2,136	ft. 20-inch reinforced sewer
800	ft. 48 x 43-inch reinforced sewer
2,600	ft. 12-inch corrugated culvert
410	ft. 18-inch corrugated culvert
500	ft. 24-inch corrugated culvert
570	ft. 30-inch corrugated culvert
1,000	yds. concrete walls
300	yds. rubble masonry
2,500	yds. rubble parapet
2,000	sq. yds. rock slope
6,800	ft. guard fence
37	M ft. B.M. lumber
28	M ft. B.M. lumber dressed
25,000	yds. crushed rock macadam
1,050	yds. crushed rock base
5,700	yds. 5-inch asphalt pavement
5,700	sq. yds. 5-inch Warrenite pavement
25,000	yds. gravel macadam

Wren and Greenough have sublet about one-half of the work and have their own forces on the remaining portion.

Excavation Equipment

The accompanying profile shows the gradient and ground line, as well as the approximate general quantities of roadbed excavation within each of the contract limits. On the profile are also shown the location of the ten power shovels engaged on the work as of August 20. Approximately 33 per cent of the excavation was accomplished in the first two months of the job. The operation schedule calls for 18 hours per day from 6 A.M. to midnight on weekdays and Sundays. There are six Marion shovels, three of which are gas-electric models, one Northwest, two Bucyrus, and one Lorain

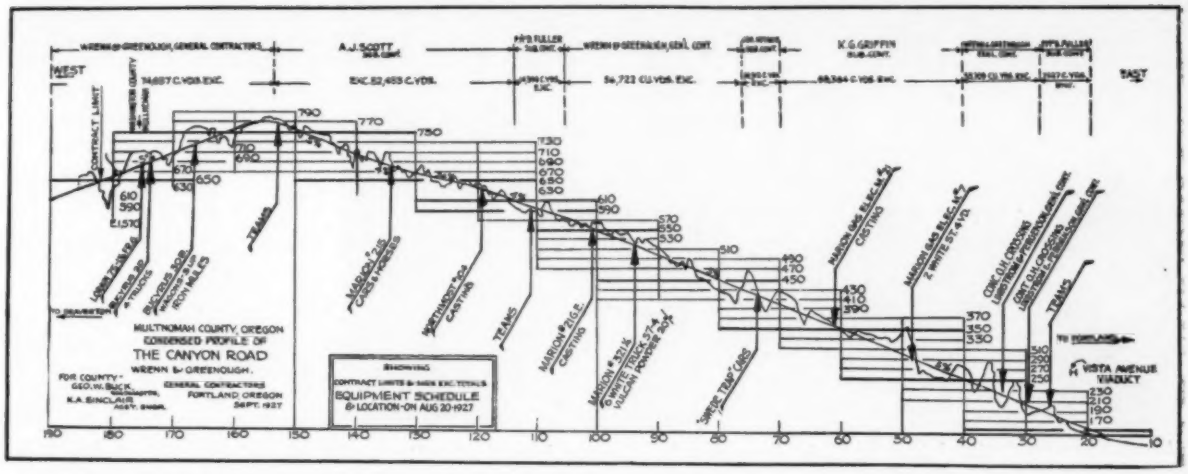


Diagram Shows Contract Limits, Excavation Totals and Location of Various Excavation Units on August 20, 1927

shovel on the three miles of this project being built by Multnomah County.

Of the six Marions on the job, three are steam-rigged with water lines and an oil supply to serve them. The often remarked resiliency of the steam rigging is apparent in the heavy work these shovels are doing. The two Marion gas-electrics, one Model 21 and one Model 7 shovels, are also working successfully in rocky materials. All other shovels are straight diesels or distillate-burning machines.

Convenient tool boxes, spare parts, facilities to repair and access to supply depots in Portland, as well as extremely close inspection and watchfulness have prevented serious excavating delays, though the machines are constantly pressed in the long 18-hour stretches working every day. The vigilance exercised in keeping haulage equipment always up to the shovel is one of the strongest points noticeable in the handling of all the work. The old adage that "a power shovel is only useful when its dipper is going up and down" is apparently the chief doctrine of these contractors.

The loose and solid rock work lying on the easterly two-thirds of the project is nearly all being done by Marion shovels. The through cuts on the west are deep, wide and mostly through a brick clay material. The general contractors concentrated on the western clay cuts with a view to having them completely ditched, sloped and finished before any possible occurrence of rain and the resultant mud, which explains the presence of three shovels in one thousand feet.

As the old road is laid close to the canyon bed, drainage is an acute problem. A concrete storm sewer runs alongside the old road and is preserved with its manholes raised to the new grade and with suitable catchments.

Most of the culvert work is for passing the collection in local water pocketing areas under the new grade and leading the water into the storm sewer. It is primarily accomplished with 24-, 30- and 36-inch concrete pipe furnished by the Concrete Pipe Co. of Portland.

White 5-yard trucks with 4-yard dump bodies, many of which are operated by Wood hoists, predominate in the hauling. Various types and makes of compressors, furnished by the Burke Machinery Co. of Portland, and a considerable variety of drilling machinery are used on the rocky sections. Nearly 3,000 tons of reinforcing steel, furnished by the Mercer Steel Co. of Portland, are used in the bridges being built by Lindstrom and Feigenson and in the retaining wall and drainage work being done by Wren and Greenough.

CONSTRUCTION

Several deep cuts are being handled in two lifts. Cuts which will stand side-acting are opened up and an open way thus rapidly established for truck and car ways. Use of the old pavement in long haul distribution is made in many cases, and fills are steeply ramped up to grade from the pavement edge and faces placed for topping out for distribution to be made later at grade level.

The road bed is 57 feet wide on both cuts and fills. Waterbound macadam laid 9 inches and compacted by rolling to 6 inches will be the base for the top surface. Porous drain tile 8 inches in diameter is being used on all earth cuts with a coarse gravel backfill. Eventually, when settlement stops, a 38-foot concrete pavement 11 inches at the edges, 9 inches at quarters, and 11 inches

Bucyrus 30-B 1¼-yard Shovel in Bottom Lift of Cut Loading Bates Iron Mule

Looking Toward Portland, Showing Vista Avenue Viaduct Leading from the City to Portland Heights, and Also Forms for Two Over Crossings of the New Road Over the Old Road Pavement

in the center, will be laid. Concrete curb and a 6-foot screening sidewalk will be built on one side.

A system of permits is used during working hours for the passage of traffic on the old road. Several adjacent construction operations in progress and the delivery of material to the Canyon Road job require a steady procession of material trucks and various passenger cars for business on the job. These go in and out regularly, but general travel is diverted to other routes.

There is only one curve over 12 degrees. That is shown in the above illustration. The grade work is awaiting the early completion of the two overcrossings which will not only give access to the cut but give haulage way from it and through it. The bridges were completed about September 20 and the outfit in use on the west end was moved through there to the lower heavy road work and intermediate rocky point which were not embarrassed by the fall rains.

On the cuts being top-lifted near the summit, Bates Iron Mules with forward tilting bodies and dump wagons are finding usefulness through allowing deeper cutting by the shovel on account of the low loading height of the hauling equipment. The Iron Mules and the regular horses make an odd-looking, but highly businesslike haul-away train in the service of this shovel.

All haulage trucks used are given a couple of shovelfuls of sawdust over the body bottoms as they pass into the cuts to load. A sawdust supply dump truck is kept busy delivering this material which comes from one of the great sawmills out of Portland. The sawdust gives a clean bottom on which to load and supplies a dry film between the heavy muck and the steel body bed. The truck body bottoms shine and keep slick surfaces for free dumping as the result.

The use of a "swede trap" by George Kotakis in a deep, side hill, loose and well-shot solid rock cut at Station 72 is providing an expeditious method of handling this particular work.

Many teams are used in drainage work, side ramps and in the lighter roadbed work at places along the line where their use is found economical.

CITY END OF PROJECT

The city end of the job is making rapid progress through ordinarily tedious legal stages and will involve much repairing, street widening and regrading to hold uniform the 5 per cent maximum grade, and those added widths of city entrance streets necessary to accommodate the slowing down to a permissible city pace of the expected fast traffic from and to the open Canyon Boulevard beyond.

PERSONNEL

The present commissioners of Multnomah County are Amadee Smith, Chairman, Grant Phegley and Clay S. Morse. The approach improvements are under the direct charge of George W. Buck, Roadmaster and Engineer in Chief and the Canyon Road work is being handled by K. A. Sinclair, Assistant Engineer. The job was practically completed in December, 1927.

The work in Washington County to the west is surveyed and will be pushed by the county and the Oregon State Highway Commission as rapidly as right of way can be obtained.

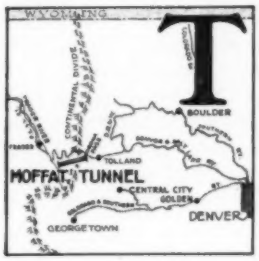
Truck from Lorain Shovel Dumping on the Top Lift. The Old Road Passes Under a Temporary Bridge, and Furnished a Paved Route for Trucks from the East End of the Cut to Dump on the Lower Lift Seen at the Left

A careful check-up on the cause of accidents in industry shows that seven out of every ten are preventable, and that only two of the seven are preventable by mechanical means. The remaining five can be prevented by education of the worker in safe habits and practices.

Equipment Used in Driving the Moffat Tunnel

By D. W. Brunton

Chairman, Consulting Engineers, Moffat Tunnel Commission, Denver, Colo.



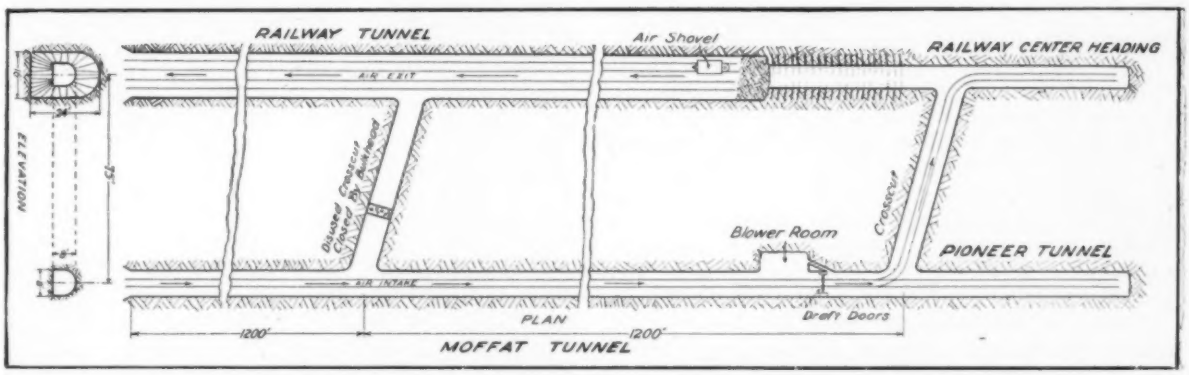
THE Rocky Mountain chain reaches its culmination in Colorado, as there are more square miles of mountain tableland above 10,000 feet elevation and more mountain peaks above 14,000 feet elevation in Colorado than in all of the other states in the Union. For this reason, the Union Pacific Railway in crossing the continent veered to the north, avoiding Colorado entirely and going through Wyoming, while the Santa Fe Railway for the same reason swung down to the south through New Mexico. In Colorado, the Continental Divide is crossed by the Rio Grande Western Railway in three places, but in doing so it traverses Tennessee Pass at 10,240, Marshall Pass at 10,856, and Cumbres at 10,015 feet elevation. In addition to having to cross the Continental Divide at these high elevations, it has been necessary to zigzag across the state to obtain water grades by following the principal streams, which has increased the mileage to such an extent that the distance from Denver to the Utah state line on the main line of the Rio Grande Western is double the airline distance.

The Denver & Salt Lake Railway is now completed as far west as Craig, 255 miles from Denver, and crosses the Continental Divide through Corona Pass at an elevation of 11,660 feet, and to avoid this climb the Moffat Tunnel is now being constructed. During the winter months in Colorado, snowstorms do not seriously interfere with railroad operation up to 9,000 feet, but above that elevation the snowfall increases rapidly and at the same time drifts more readily, and there are times when it is impossible to maintain regular train service no matter how many snowplows are put into service.

To determine the most available point for the tunnel, a 9,000-foot contour line was run on both sides of the range for thirty or forty miles to determine the closest approach of these lines to each other. On the best and most direct line between Denver and Salt Lake this point was found to be about three miles from Tolland, a station on the Denver & Salt Lake forty-seven miles from Denver, where the old glacial valleys, now occupied by the Fraser River on the west side of the Continental Divide and South Boulder Creek on the east, come within six miles of each other.

The Pioneer System of Tunneling and Its Advantages

The pioneer system of tunneling had been so successfully used in the Simplon 12.4-mile tunnel in the Swiss Alps and the Rogers Pass 5-mile tunnel on the Canadian Pacific that it was decided to employ this method in driving the tunnel through the range at this point. An additional reason for the use of this system was that the pioneer tunnel, after the completion of the main tunnel, could be used as a conduit to carry water from the Fraser River to the eastern slope for the city of Denver.



Section and Plan Showing the Pioneer System of Tunneling Used in Driving the Moffat Tunnel

When a pioneer tunnel is used in conjunction with a railway heading, the two are connected by a series of cross-cuts usually 1,200 feet apart, and the piping and supplies for the railroad heading are brought in through the pioneer tunnel and cross-cut instead of through the completed railroad tunnel. All traffic connected with driving the railroad heading is carried on through the pioneer tunnel, thereby entirely obviating interference with the work of enlarging the heading to full tunnel size.

When the rock is sufficiently hard to stand without support, the enlargement is carried on by what is known as ring drilling from the center heading, and in order that blasting may not interfere with drilling, the latter is usually kept several hundred feet ahead of the face of the bench. The ring drill holes are usually four feet apart, and when shot, from three to four rings are

Device Used in Ring Drilling

loaded simultaneously and fired in quick succession by electric delay fuses. In order that the drill holes in each ring should be in a uniform plane, accurately spaced, and drilled to the correct depth, a circular plate was bolted to the drill column and on it the exact position of the drill for each hole was plainly marked. By using this device the drill holes were accurately placed, which was far from being the case where the miners were allowed to use their individual judgment.

The pioneer system of tunneling, in addition to its other advantages, greatly facilitates and cheapens ventilation, as the pioneer can be used as an air intake, while the main tunnel forms an exhaust conduit to carry off the products of explosion. In the workings from each portal two horizontal 16-cubic-foot impeller-type blowers are used each operated by 100-h.p., 2,200-volt electric motor geared to blowers with a jackshaft; capacity, 4,000 cubic feet of free air per minute at 4 pounds pressure. One of these blowers supplies air through a 12-inch pipe to the face of the pioneer tunnel, and the other blower, through a 12-inch pipe, carries the air to the face of the center heading. As these two streams of air force back the gases from the face of the headings, a draft door in the pioneer tunnel compels all of the gases to travel outward through a portion of the railway heading into the completed tunnel. As these gases have only had a dilution of 8,000 cubic feet per minute, they would affect the health and comfort of the men working on the bench enlarging the railroad heading to the full size tunnel. To obviate this, an electric-driven fan of 16,000 cubic feet capacity is used in conjunction with the blowers, but as its delivery pipe is only long enough to reach from the blower chamber on the side of the pioneer tunnel to the inner side of the draft door, the frictional resistance is slight and a few ounces pressure is amply sufficient. This additional amount of air dilutes the gases to such an extent that they are scarcely noticed by the workmen engaged on the enlargement.

Derrick on Rear End of Shovel for Picking up Empty Cars and Depositing Them on Loading Track

AIR-COMPRESSOR EQUIPMENT

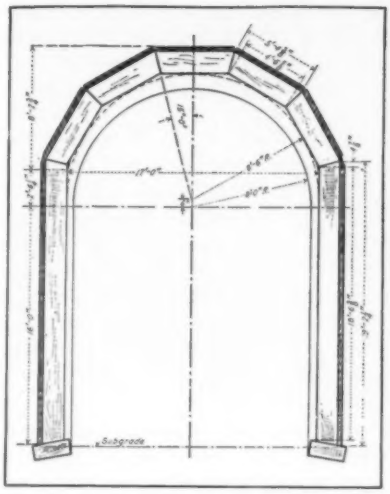
Compressed air for the workings from the West Portal is furnished by three 20- x 11- x 14-inch compressors, capacity 1,126 cubic feet of free air per minute. Each compressor is operated by a 200-h.p. synchronous motor running at 600 r.p.m.

Pneumatic Crawl for Shifting Empty Cars in Pioneer Tunnel to One Side to Allow Loaded Cars to Pass

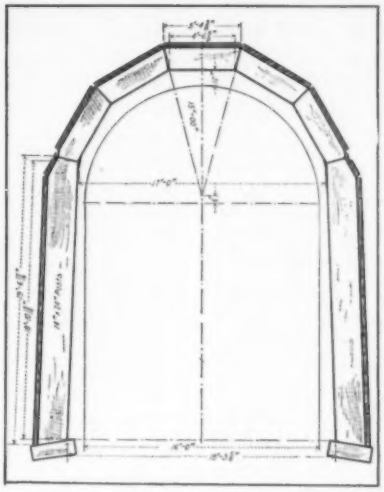
There is also one 13- x 7- x 10-inch compressor, capacity 478 cubic feet of free air per minute, operated by a 75--h.p., induction motor operating on a 2,200-volt circuit.

Compressed air for the machines at the East Portal is supplied by three 20- x 12- x 14-inch compressors, and one 20- x 11- x 14-inch compressor, each having a capacity of 1,126 cubic feet of free air per minute. These four compressors are each operated by a 200-h.p. synchronous motor running at 600 r.p.m.

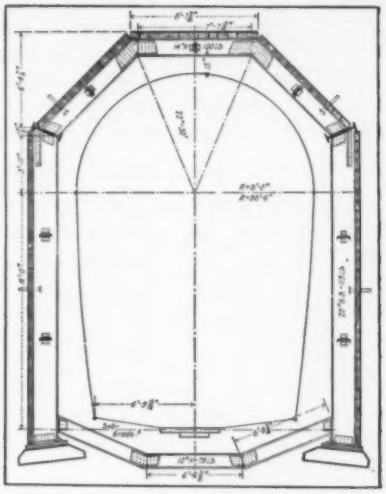
In addition to the above, there is also one 15- x 8- x 12-inch compressor, capacity 677 cubic feet of free air per minute, operated by a 75-h.p. 2,200-volt induction motor.



Timber Supports for Soft Ground



Timber Supports for Softer Ground Than Where Those Shown in the Previous Illustration Were Employed



20-inch I-beam Supports for Very Soft Ground

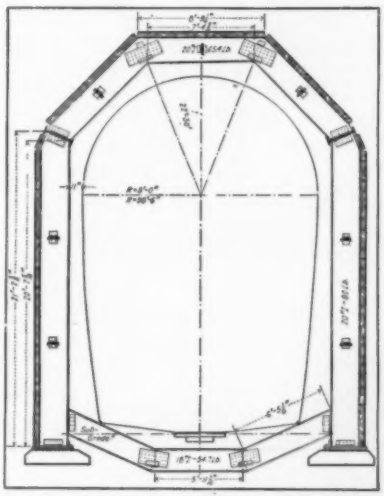
TRANSPORTING MUCK FROM TUNNEL HEADINGS

For transporting the muck from the pioneer and railroad tunnel headings, 24-inch gage cars of 50 cubic feet capacity are used, which are hauled by storage-battery locomotives.

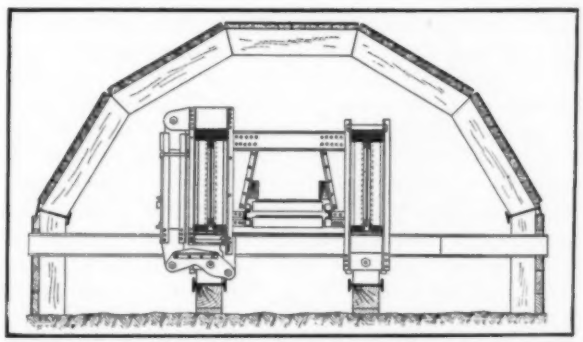
Ten-ton shovels with cast-steel locomotive frames, 24-inch gage, with 40-h.p., 250-volt d.c. motors are used.

At first the empty cars were held on a siding and brought forward to the loading machine whenever the loaded car from the face was run past the switch. It was found, however, that it was difficult to keep the switch close enough to the face, and to avoid delay in tramming and consequent idle time on the part of the loader, a pneumatic crawl was designed, in the use of which the empty car is brought up near the face immediately behind the car that is being loaded. When the loaded car is ready to be pushed back, the empty is picked up by the crawl and shoved over to one side to allow the loaded car to pass, and then pushed back and propped on the track so that the idle time of the loading machine is greatly reduced, as it only requires a fraction of a minute to make the transfer.

In the railroad tunnel, 36-inch gage air shovels are used, the shovels being especially equipped with short booms, 11-foot dipper sticks, and manganese-steel buckets of 1 cubic yard capacity, and operated by compressed air at 90 pounds pressure, using a maximum of 1,000 cubic feet of free air per minute. These shovels load directly into 36-inch-gage two-way dump cars of 4 cubic yard capacity, built to special design for clearance.



24-inch I-beam Supports for Resisting Thrust Due to Rock Flowage Near Center of Tunnel



Section of Lewis Traveling Cantilever Girder Showing Belt Conveyor for Removing Muck from the Heading

The railroad tunnel is double-tracked, the shovel and the empty cars being kept on one track, the other being reserved for loading and loaded cars. To avoid the constant moving of switches, a derrick is placed on the rear end of the shovel which picks the empty cars up and deposits them on the loading track as fast as the loaded cars are pushed back from the front. This derrick performs practically the same service as the crawl in the headings, but of course is of much larger and heavier construction, and as it moves forward with the shovel it is always in the most desirable position for car shifting.

The contractors' 4-cubic-yard dump cars used in the

tunnel are handled by 8-ton, 36-inch gas electric locomotives. Some of these locomotives are equipped with automatic reels for gathering cars ahead of the trolley wire. They also use two 6-ton trolley locomotives and an 8-ton double-motor trolley locomotive; the last three locomotives were purchased second hand.

SUPPORTS USED IN WORKINGS

In the workings from the East Portal and in some of the ground encountered in the workings from the West Portal, the rock was sufficiently hard to be self-sustaining, but unfortunately in some places it had to be supported by 12- x 18-inch Oregon timbers. As the headings from the West Portal advanced, the ground became softer and 14- x 24-inch Oregon fir timbers were used. When the ground became still weaker, timber supports were discarded and 20-inch I-beams used in their place. To keep the bottom from rising, a three-piece arch of 12-inch I-beams was used. Near the center of the tunnel, which is 2,762 feet below the crest of the range, rock flowage became so pronounced that 24-inch steel I-beam sets, 3 feet apart, were required to withstand

Crushing of Wall Plates Under Extreme Pressure Resulting in Throwing Timbers Out of Line

the thrust, and to prevent the bottom of the tunnel from rising a three-piece arch of 18-inch steel I-beams was required.

Before the tunnel is used, the space between and in front of these I-beams to the net line will be filled with concrete, which will perform the double function of strengthening the arch and protecting the steel beams from rust.

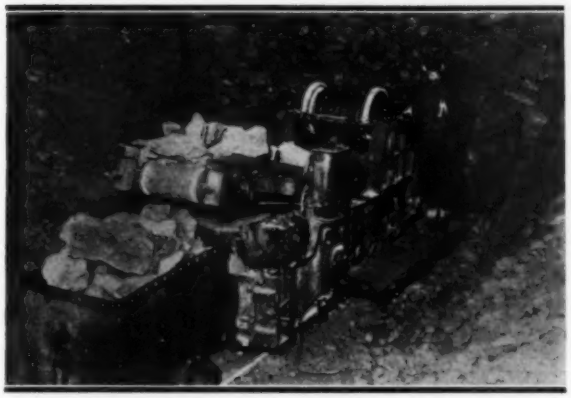
Where the ground was sufficiently firm to stand without support, a center heading was used, but where timbering was necessary, the top heading system was employed which was then widened out to the full width and the arches supported on wall plates. In excavating the bench, raker posts were at first employed, but later this system of supporting the wall plates which carry the arches was superseded by the Lewis cantilever. In this system two 60-foot steel beams rest for two-thirds of their length on the bench, and the portion projecting over the part to be excavated carries heavy cross-arms which support the wall plates and hold the arch in position until the bench can be completely excavated and the posts placed in position, after which the cross-arms are retracted and the cantilever moved forward eighteen or twenty feet and the process repeated.

Toward the close of the work, when it became desirable to bring the completed tunnel closer to the point where the top heading had been enlarged to the full width of the arch, a belt conveyor was run through the center of the cantilever and the muck, taken out during the enlargement of the heading to full size,was sent out through the cantilever and dropped on the bench muck pile. This lessened the amount of muck to be sent out through the pioneer tunnel, which is single-track, and when the haul exceeded two miles became greatly congested. The belt conveyor running through the cantilever was electrically driven and could be reversed so that timber and tools could be sent in on it.

Near the center of the mountain, when the pressures became greater, it was found that when the stresses on the arch and posts were nearly equal, the 12- x 12-inch wall plates would crush and throw the timbers out of line. Where the pressures on the post and arch were unequal, the wall plates would rotate as well as crush, thereby destroying the stability of the set. To obviate this difficulty, the author introduced the use of an I-beam wall plate, which like most successful inventions immediately developed collateral advantages. As the post and arch are only separated by the web of the I-beam, rotation and crushing are impossible, and at the same time the flanges of the I-beam hold both the arch sets and posts in their relative positions during both construction and maintenance.

EXPEDITIOUS DRILLING PROCEDURE DEVELOPED

When the broken rock at the face—or "muck" as it is usually called—was loaded into the cars by hand, the customary method of operation was to level off the top of the muck pile and have the machine men commence operations by erecting the drills on a cross-bar—and they were generally able to drill the upper holes before the shovelers began to dig the ground out from under their feet. The shovels now used in the tunnel will usually clean up the muck from a round of shots in from two to two and a half hours, and as the shortened period renders it inadvisable to attempt drilling on the top of the muck pile, the face is therefore cleaned up before drilling commences. It has been found both expeditious and economical to lay the rails up to the face as soon as the mucking is completed, and the four rock drills used in the heading are now mounted on a heavy carriage which can be run directly up to the face. These drills are always kept on the carriage and their air and water pipes connected to a manifold on the car, so that to begin drilling it is only necessary to connect the main compressed-air and water pipes with the manifold and run out the jackscrews to hold the car in position, operations which usually take from fifteen to eighteen minutes. Under the systems formerly employed the drills and the columns had to be carried back from the face by the men, far enough to be safe from flying rock, and in setting them up again they of course had to be brought back in the same manner, and by the time the columns were set up and the drills in place ready to run, the men were nearly tired out. Under the new system they begin drilling



Shovel Removing Broken Rock from Face of Tunnel

perfectly fresh, and of course are able to work much more efficiently, a condition clearly proved by the reduced amount of drill repairs.

DRILLING, LOADING, AND FIRING SYNCHRONIZED WITH MUCKING AND BRINGING UP RAILS

As the railroad heading and the pioneer tunnel are carried forward at approximately the same rate of progress, it has been found desirable to synchronize the operations of drilling, loading, and firing with those of mucking and bringing the rails up to the face. Under this system, when the drillers are at work in the face of the pioneer tunnel the muckers are cleaning up the face of the railway heading, and as both operations are timed to be completed simultaneously, the machine men run their drill carriage and the muckers their loading machine back to the nearest cross-cut and change places. Under this system, even in the hardest rock, the machine men can readily drill, load, and fire two rounds in an eight-hour shift, one in each heading. Where conditions are favorable, eight rounds are often drilled in twenty-four hours.

Electric power for both portals is supplied from the Boulder Canyon hydro-electric plant of the Public Service Company. From the power plant to the East Portal the distance is twenty-two miles; the voltage is 44,000. Power for the West Portal is taken from the East Portal over a seven-mile temporary line, which crosses the Continental Divide at an elevation of 12,000 feet and will be taken down when the tunnel is completed.

MISCELLANEOUS EQUIPMENT

Both portals have well-equipped blacksmith and machine shops, also charging stations for the storage-battery locomotives.

In driving the headings, drifters are used; in the radial drilling from the center heading, stoppers are generally used on the upper holes, while jackhammers are sometimes used in connection with the other drills on the bench.

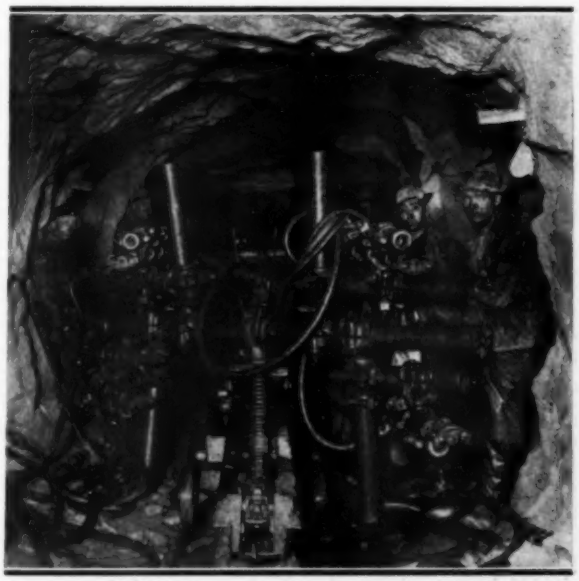
The rock encountered in the workings from the East Portal was generally hard and self-supporting, consequently greater speed was obtained there than in the workings from the West Portal where the rock was crushed and required timbering. As a consequence the headings, instead of meeting at the apexes as was intended were thousands of feet apart when the east headings reached that point and it was necessary to continue them down hill on a grade of eight-tenths of one per cent. Owing to the natural depravity of inanimate things, a heavy flow of water, amounting at times to 3,500 gallons per minute, was encountered in these down-grade headings, which greatly reduced the rate of progress and necessitated the employment of an expensive electric pumping equipment consisting of three centrifugal pumps, 2,000-, 1,200-, and 1,000-gallons. As the lift was slight, these pumps were easily operated, but, unfortunately, once during a severe storm a break occurred in the electric line and the pumps were submerged before power-line repairs could be completed.

Drill sharpeners are used at both portals and give excellent satisfaction, but their full benefit was not reached, and the oil forging and tempering furnaces should have been equipped with pyrometers so that correct temperatures could always be maintained. No matter how skillful a blacksmith may be, the apparent temperature of steel is greatly modified by changes from sunlight to shadow and from day to night. As a consequence, breakage of steel has been abnormally high, ranging from 2.2 to 4 per cent, and at one time for a few days, owing to an unnoticed defect in one of the sharpener dollies, breakages ran up to 15 per cent.

The consulting and construction engineers have unanimously recommended that all trains be hauled through the tunnel by electric locomotives. Unfortunately, all connection of the engineers with the tunnel ceases on its completion, and it is understood that the Denver & Salt Lake Railway will not consent to electrification.

The contract for the tunnels was let on September 20, 1923, and the pioneer tunnel was holed through February 18, 1927, the final blast being fired by President Coolidge pressing a button in Washington. The railroad tunnel headings met on July 13, and railway trains may now pass through the tunnel.

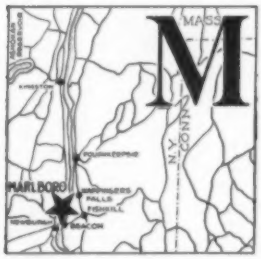
EDITORIAL NOTE: The article is printed through the courtesy of *Mechanical Engineering*. For an interesting series of progress photographs of work in the Moffat Tunnel see CONTRACTORS AND ENGINEERS MONTHLY, October, 1924. Another article appeared in March, 1927.



Four Rock Drills Mounted on Heavy Carriage Which Can Be Run Directly up to Face

Apple Orchard to Aggregate

Rosoff Sand and Gravel Plant Produces Clean Sand and Gravel for Concrete



MOST travelers on the Hudson River above New York City admire the beauties of the Palisades, but few notice the fleets of barges that carry clean sand and gravel from the Rosoff Sand and Gravel Co. plant at Marlboro, N. Y., to the great market in the city downstream where it is converted into the form of sky-scraper and subway. Sam Rosoff, whose biography appeared in the September, 1927, issue of CONTRACTORS AND ENGINEERS MONTHLY, has operated this plant for a number of years as a means of insuring the sand and gravel supply for his New York subway contracts and also as a commercial enterprise.

Viewed from the Hudson River the operation seems small. This is because the pit extends far back from the river front and to the south, where it is hidden by a bluff that affords a magnificent view of the mighty river of the east. In fact, not long ago a big barbecue and picnic was held on this site for the officials and engineers allied with the subway work in New York. Near the south end of the pit is the huge Bucyrus Model-175 steam shovel that has been slowly eating its way into the hillside for 11 years to remove over 6,000,000 yards of bank-run material. The shovel weighs 235 tons and is equipped with a 75-foot boom, a 55-foot stick and a 3½-yard dipper. As if to accentuate the size of the shovel there is a Bucyrus Model-20 nearby to clean up and help in moving the track that serves the big shovel.

A standard-gage industrial railway track runs to all sections of the pit where operations are current. On this track three trains of 6- to 7-yard Koppel dump cars, three cars to a train, are hauled from the shovel to the bins by American steam locomotives. This makes it possible for one train to be at the loading bin by the shovel, a second en route and the third unloading. The cars are loaded by the big shovel through a small loading bin which has no gate. When it is necessary to move ahead the big shovel picks up the loading bin and moves it along the necessary distance. Water for the shovel is furnished by a small Blake reciprocating pump in the pump house about a quarter of a mile away on the river bank. This pump maintains about 100 pounds pressure on the line. Coal is brought up in 1-horse dump carts which empty into a skip which is hoisted to the coal bunker on the shovel by a small derrick directly attached to the shovel.

CRUSHING AND CONVEYING EQUIPMENT

The material dumped by the industrial railway cars into the receiving bin, which has a capacity of five cars, is fed by a reciprocating feeder onto a belt conveyor which delivers it to the first screen. This is a 60-inch x 16-foot Austin screen which removes all the stone over 2¼-inch size and returns it to the No. 7½ Austin crusher. An Austin bucket conveyor carries all this crushed material to a 48-inch x 12-foot Austin screen, the rejects from which go to two No. 4 crushers and thence to a 36-inch x 12-foot screen.

The material is then delivered to a ½-inch x 36-inch belt running on Link-Belt, Robins and Jeffrey idlers and 192 feet between pulleys to the washing equipment in the second building.

WASHING EQUIPMENT

As the material is delivered to the top of the belt incline, it falls into a box into which a stream of water is poured by one of the two Cameron 2400-gallon centrifugal pumps in the river bank pump house. A vane acting like a rudder divides the stream of water and crushed gravel and sand between the two banks of washers. These washers consist of two scrubbers to which 1200 gallons of water each are supplied by the second 2400-gallon Cameron pump. The material progresses downward through three ⅜-inch, three ¾-inch and two 1½-inch rotary screens, the two latter having the scrubbers mentioned above.

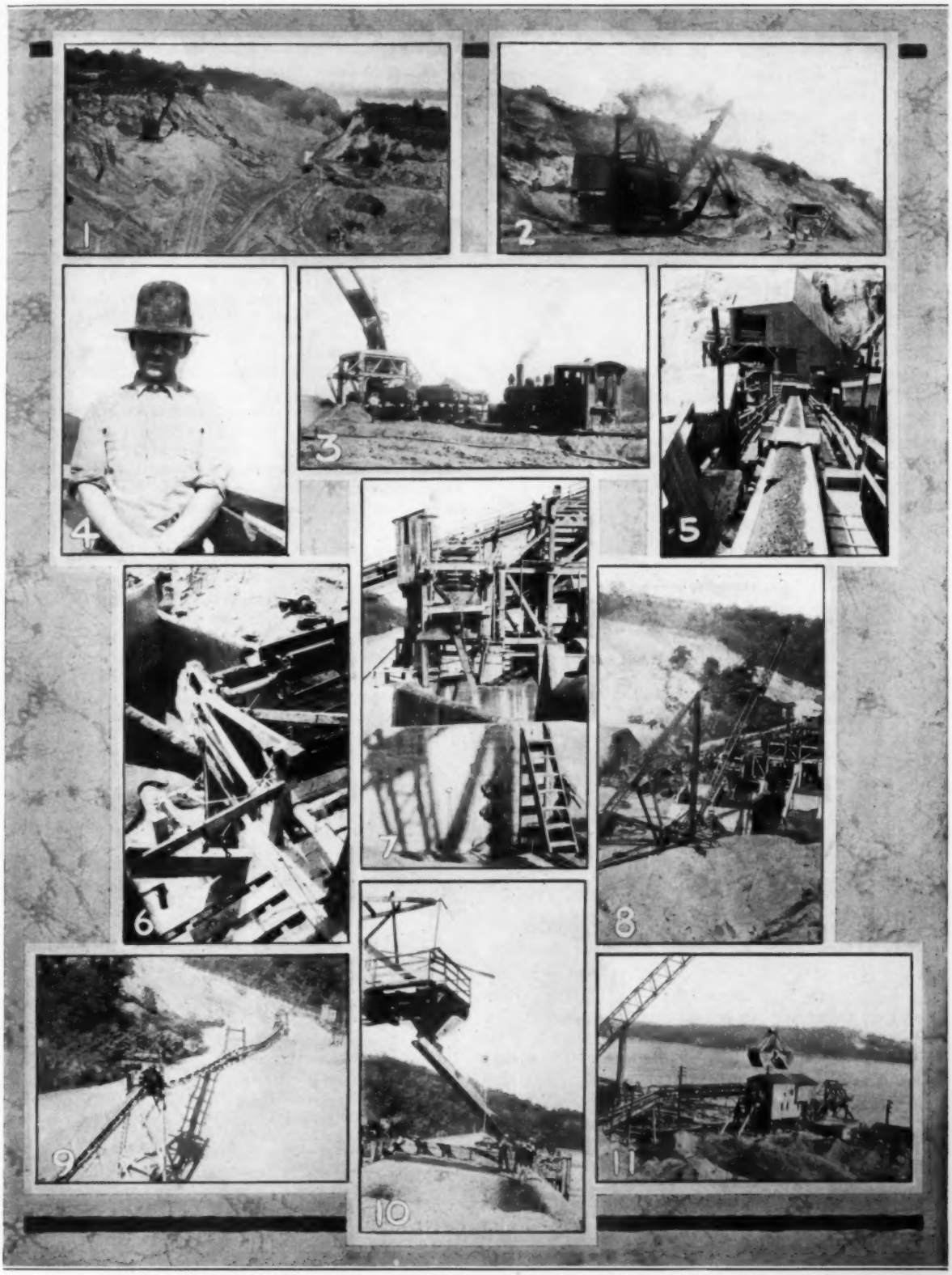
All eight screens and the belt conveyor are run by one 40-horsepower electric motor. The two scrubbers are operated by a separate 15-horsepower motor.

The final shaker washer screens for gravel are situated one above the other and are each 25 feet long and 5 feet wide, with an incline of 1½ inches per foot. They are made by the Hendrick Mfg. Co., Carbondale, Pa., and use 1100 gallons of water per minute.

SAND SCRUBBER

Gravel from the primary washers falls into the various concrete storage bins beneath the conveyor and screening units. The sand runs into a separate bin, from which it is raised by an endless-chain scraper built of Taylor-Wharton manganese steel links and high-carbon pins and sheet steel paddles. This sand washer conveyor pushes the sand up the inclined side of the bin and over into a receiving bin below. Here the water runs off through a series of openings controlled by sluice gates in the front of the tank. The sand is remarkably clean and receives no further washing before delivery to the consumer. Gravel, however, when taken from storage is always washed again before delivery to the barge. A 2½-yard Hayward bucket removes the sand from one of the two receiving tanks while the other is being filled. The bucket piles the sand to the south of the washing plant over a conveying system built in a tunnel. During a period when there was an unusual demand for gravel and little demand for sand the surplus sand was piled farther to the south by means of a Sauerman Junior dragline scraper.

The large derrick that handles the sand from the



SCENES AT THE ROSOFF SAND AND GRAVEL COMPANY'S PIT AT MARLBORO, N. Y.

1. A general view of the pit looking north with the Hudson River in the background. 2. The Bucyrus 175 steam shovel. 3. A train of three Koppel 6-yard dump cars. 4. H. J. Trowbridge, Superintendent. 5. The main belt from the crushers to the washers. 6. The Taylor-Wharton sand washer conveyor. 7. Side view of the sand washer conveyor. 8. Steel derrick for removing sand from bins to storage. 9. Belt conveyor for moving ⅜-inch gravel to storage. 10. Method of loading barges. 11. The gravel rewash plant and loading house.

settling tanks to storage is operated by a Flory steam hoisting engine. It is built with a Terry mast and bull-wheel and a New England Structural Steel Co. steel boom and stiff legs.

When sand is to be loaded onto barges, the conveyor in the tunnel below the storage pile is started. This feeder conveyor runs at the rate of 400 feet per minute. The next or delivery belt running at right angles to the feeder belt operates at 420 feet per minute and the final delivery belt to the barge runs at 450 feet per minute. This increased speed as the sand approaches the barge prevents any chance of piling up at any point in its travel. Final delivery to the barges is controlled by a spout on a roller turntable. This is manipulated by the loader with great skill.

PUMPING AND POWER PLANT

The pumping plant for the Rosoff plant consists of three Cameron centrifugal motor-driven pumps of 2400, 2400, and 1100-gallons capacity, and one Alberger pump of 2000-gallons capacity per minute running at 1800 r.p.m. against 125-feet head.

The pump house is a galvanized iron building, in which the pumps are grouped as follows: at the north end the two Cameron 2400-gallon pumps with their 100-horsepower Westinghouse motors; at the south end of the building are the 1100-gallon Cameron pump with a 50-horsepower Westinghouse motor and the 2000-gallon Alberger pump with a 100-h.p. General Electric motor.

The power plant house is a galvanized iron building containing a steam boiler to generate steam for the 2-drum Lidgerwood hoist that is used for spotting the scows when loading. A steel cable is run from a capstan on the barge through a sheave attached to one of the fender piles of the dock and thence to the hoist. The cable is carried around the drum several times and then out to another sheave and along to a capstan at the other end of the barge. Frequent shifting of the barge is necessary for satisfactory loading, as one end would be under water if gravel or sand were loaded continuously from one end toward the other. This novel spotting equipment greatly cuts down the loading time and the grief of moving the barge by hand.

The transformers for the entire plant are located in the power plant. Electric current is purchased from Hudson Gas & Elec. Co. at 2200 volts and used at 220 volts.

Steam from the boilers is also used to steam the idlers when they may have become frozen after a rain or sleet followed by freezing weather. Since the pumps have no foot valves the steam is also used to prime the pumps whenever necessary by means of an ejector. This has been found much more satisfactory than the foot valves which were constantly causing trouble from weeds and trash caught in the seats and losing the prime of the pump.

The products of the Rosoff Sand and Gravel Co. plant at Marlboro, N. Y., are washed sand, and ⅜-, ¾-, and 1½-inch gravel. H. J. Trowbridge is superintendent of the plant. The capacity of the plant is about 2000 yards of material per day. This plant operates from about the fifteenth of April, this being the opening of navigation on the Hudson River, until the close of navigation about December 1 each year. All employes are given a two weeks' vacation and then about 75 per cent of the men return to the plant and put in the entire winter completely overhauling the plant from beginning to end to insure against breakdowns the next season.

Once each year the river directly in front of the loading spout is dredged. The operation takes a complete dredging outfit of dredge tug and barges about two days at $500 a day to clean up.

Fuses, Caps and Machines in Explosives Work

THE discovery and development of the detonating fuse, the blasting cap and the blasting machine, and their importance to the explosives industry, the world's "key industry," are described in the "History of the Explosives Industry in America," which has come from the University of Columbia Press. Arthur P. Van Gelder and Hugo Schlatter, eminent American chemists, are the authors.

"In 1913," they write, "the Ensign-Bickford Co. introduced 'Cordeau' into the United States. This is a detonating fuse, invented by Louis Liheure in France, and consists of a lead tube filled with trinitrotoluene. The first blast with cordeau in America was made on August 16, 1913, at the quarry of the Atlas Portland Cement Co. at Northampton, Pa. This cordeau was of French manufacture and, during 1914, cordeau of French make was regularly imported and sold by the company. In 1914, the installation of machinery for its manufacture at Simsbury was begun. The outbreak of the European war hampered this work, as the French engineers, who were to have set up the machinery, had to return to France. Nevertheless, the installation was completed after some delay, and in 1915, the American product was put on the market as 'Cordeau Bickford.' It was enthusiastically received by the trade and is now widely used by quarries and mines for deep well holes, for blasts where many holes have to be shot at one time, and for sub-aqueous work. It is also used for testing the velocity of detonation of other explosives."

The percussion cap was invented sometime between 1810 and 1820. The invention of the fulminate cap made the modern rifle and shotgun cartridge possible, and it is unfortunate that it can not be definitely determined who was the inventor.

"For blasting, as long as black powder only was used, caps or detonators were not necessary for the miner who could explode his powder by the use of a simple fuse. Nevertheless, where shots had to be fired from a distance, as in military land and sea mines or in deep holes, or where a number of blasts had to be set off simultaneously, other means than the fuse were desirable, and we find early attempts to do this by electricity and by electric igniters or exploders.

"It was only after Nobel had introduced nitroglycerin and dynamite that exploders, whether electric or the common blasting cap, became a necessity when 'high explosives' were used.

"The electrical ignition of gunpowder seems to have been accomplished first by Dr. Watson, a member of the Royal Society of England, in 1745, by means of an electric spark. In 1856, Sir Charles Wheatsone, who was working with Professor Abel in England to improve existing methods for exploding mines, invented the earliest form of magneto-electric apparatus suitable for field use.

"The first common blasting caps used in America were imported from Germany, although at the time blasting caps or 'fuzes' were being manufactured in America to a considerable extent. This was about 1880. Both common and electric caps include the use of picric acid, trinitrotoluene and tetryl as intermediary substances or 'boosters' between the fulminate and explosive proper, and the use of salts of hydronitric acid, for instance, lead azide, in place of fulminate.

"Mechanically, the electric exploders have been improved until today they are water-resistant under considerable pressure. Loading arrangements have been perfected so as to do away with a great deal of hand labor and hazard, besides improving their uniformity and regularity of action."

Equipment in Kansas Road Work

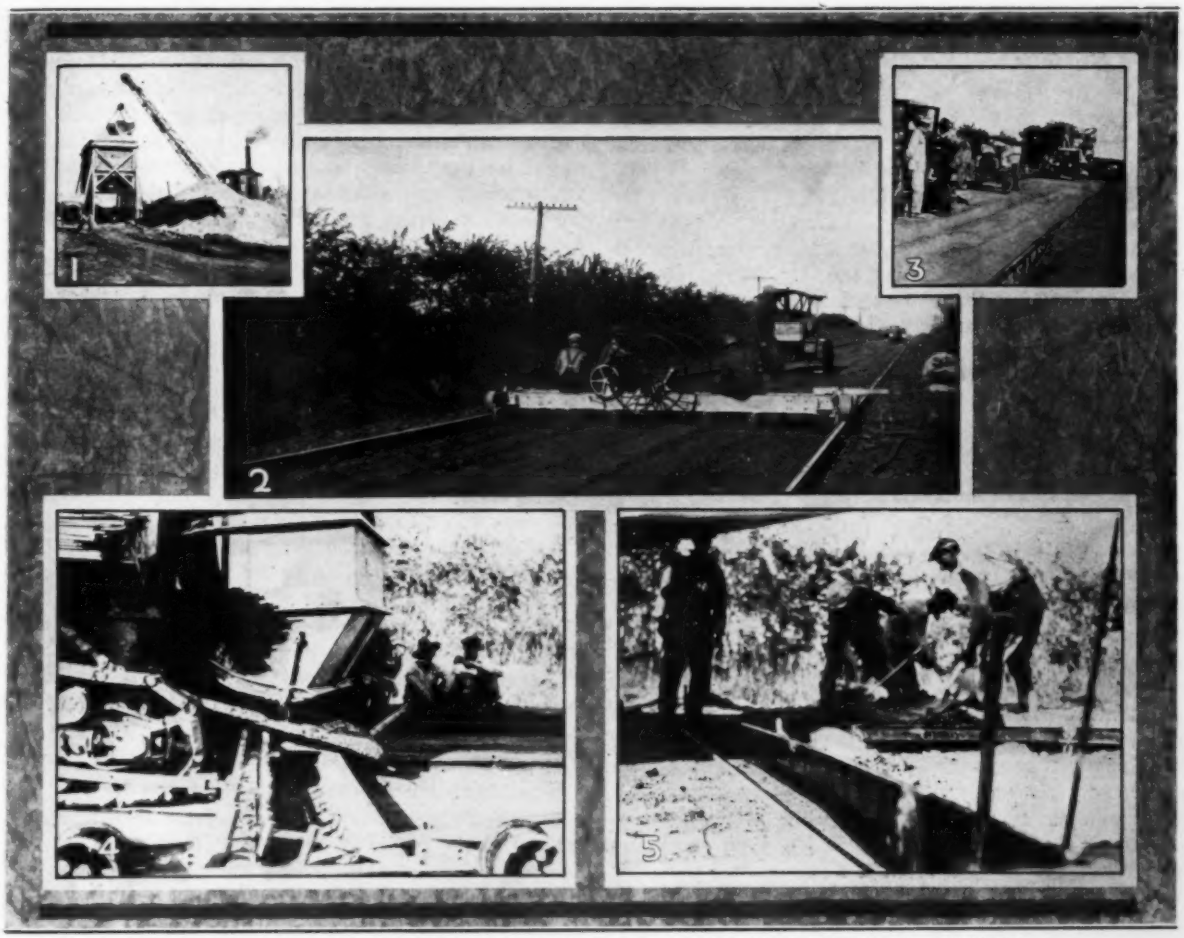
By H. D. Barnes

Division Engineer, State Highway Commission, Chanute, Kansas.

IT must be generally conceded that equipment and organization have a very definite relation to the kind of job and the amount of profit obtained in road contracting. It might further be conceded that as long as labor saving equipment can be kept continuously in use it will return a good percentage of profit. A certain amount of equipment is ordinarily necessary for the proper prosecution of any road contract. Therefore the ideal condition is one in which the contractor has sufficient equipment for the proper handling of the work and has an organization that will function so that the equipment will be in use a maximum amount of time on work for which it was designed to be used.

F. A. P. 109

One of the year's outstanding paving contracts in Kansas is being constructed with as nearly ideal relations between equipment and organization as it has ever been our pleasure to witness. We refer to the construction of Federal Aid Project 109, Sections A, B, and C, in Linn County, by the C. H. Atkinson Paving Co. of Watertown, South Dakota. The contract consisted of approximately 22 miles of 9-6-9-inch concrete paving. We wish to refer in particular to Sections A and B, which totaled approximately 13 miles in length. This work was under the superintendence of F. T. Erickson, Vice-president of the company, and H. J. Abbey was Resident Engineer on the job for the state. The road contract is on U. S. 73-E, from Pres-



CONSTRUCTION EQUIPMENT USED ON F.A.P. 109 IN LINN COUNTY, KANSAS

1. Osgood crane loading sand and stone from the stock piles into the Johnson bins. 2. Lakewood subgrader with "live load." hauled by crawler tractor. 3. Turntable for trucks hauling dry batches to the mixer. Note the excellent condition of the sub grade due to the use of light trucks on pneumatic tires. 4. Koehring subgrade scarifier and planer pulled behind the mixer 5. Metal plate installed while pouring to leave space for expansion joint. The metal was later removed and the space filled with asphalt.

cott through Pleasanton, to a point three miles east of LaCygne.

WORK PRECEDING PAVING

The grade and culverts were completed several years in advance of the letting of the paving contract. All fills were constructed on a 2:1 slope and wooden guard rail was placed on all fills over 4 feet in height, The guard rail was so much in the way of paving operations that the most of it was removed and will not be replaced but the slopes will be increased to 3:1. This will involve considerable work where the road crosses the Marais des Cygnes river bottoms. There is a fill across this bottom of approximately 12 feet for a mile and a half. This fill was constructed with a dragline with borrow pits only 10 feet from the toe of the 2:1 slopes. The work of constructing the 3:1 slopes here will require a dragline with a long boom as the borrow must all come from the back side of the old pits.

One of the chief reasons for using 3:1 slopes on the heavy fill section was that the 2:1 slopes were eroding badly and would not sod. It is also believed that 3:1 slopes properly sodded and with willows planted at the toe of the slope will successfully withstand the action of waves which occur at flood stage of river during high winds.

EQUIPMENT

The contractor shipped his outfit to LaCygne about June 1st for his first set-up. His major equipment consisted of the following: ¾-yard Osgood crane; 75-yard Johnson bin and measuring hopper; 21-E Koehring paver; Lakewood finisher; Lakewood subgrader; Koehring subgrade planer; Carr form grader; Winchel 4-ton road roller; Best Sixty tractor; Adams 10-foot blade grader; 2,100 road feet of Metaform road rail; finishing bridge; Barnes water pump; 7 miles pipe line; Fordson blade grader; four 2-horse 6-foot blade graders; two Fordson tractors; average of 40 trucks from 1 to 3-ton capacity; turntable. Approximately 75 men were used in paving operations exclusive of truck drivers and shouldering gangs.

PAVING OPERATIONS

Paving was started June 6, 1927, and Sections A and B as referred to above were completed October 10, 1927. This involved the construction of 132,172 square yards of 9-6-9-inch, 18-feet wide, one-course concrete paving using a mix of 1:2:3½. None of the aggregates was obtained locally and three plant set-ups were made; one each at LaCygne, Boicourt, and Pleasanton. The aggregates were proportioned at the plant and hauled by truck to the mixer on the road. The length of haul varied from 1.25 to 8.75 miles. The contractor laid pavement on 78 different days. The total number of working hours were 734, which included all shut downs or delays of less than two hours duration. The average length of paving laid per hour was 90.3 feet. The 21-E mixer handled a 5-sack batch and each batch laid approximately 2.3 linear feet of pavement. The time of mixing was one minute after all materials were in the drum. The time to charge and discharge the drum averaged 20 seconds when the mixer was operated at its highest efficiency. The complete cycle therefore required 80 seconds. It is interesting to note that an average of 90 seconds was maintained for each cycle on the whole job, which, as noted above, included shut downs and delays of less than two hours duration. In other words, the mixer maintained an efficiency of approximately 90 per cent throughout the entire job.

In order to maintain such a high efficiency, the organization had to be nearly perfect. Too often on paving jobs everything is ready to go except one thing, and that one thing holds up the whole job until it is ready to go. It is contended by some that on jobs where labor saving equipment is used this is more apt to happen on account of unforeseen breakdowns in machinery. On this job it was proved that proper servicing of equipment machinery will practically eliminate the necessity of delay from this cause. The maximum length of pavement laid in one day was 1,192 linear feet. There were 32 days when over 1,000 linear feet of pavement were laid, and 12 days when over 1,100 feet of paving were laid.

An outline of the complete paving operation might be of interest. The fine and coarse aggregates were unloaded from railroad cars with the crane into the material bins which were equipped with measuring hoppers. Materials were stock piled alongside when the bins were filled. The measuring hopper on the sand bin was set each morning to allow for variation in bulking of this material. Sufficient amounts of fine and coarse aggregate were dumped into a truck for one 5-sack batch and the cement was emptied on top of the loads and covered with sand at the cement car which was near the bins. Upon reaching the job the trucks were turned around by means of a turntable just in front of the mixer, and then backed up to the skip and dumped. The use of Ford, Chevrolet, and other trucks helped to prevent cutting up of the subgrade.

SETTING THE CENTER STRIP

The concrete was finished with a Lakewood finisher and long-handled wooden floats. The pavement was tested with a straight-edge continually to detect waves and these were worked out with floats from the bridge. The specifications required that the pavement should not show more than ¼-inch variation in ten feet and the most of the pavement would have passed a specification of ⅛-inch variation in ten feet. The metal center strip was held in place with the Sales center strip holders which were patented by the foreman of this job. The center strip was held rigidly in place and few places can be found where it varies more than a half-inch from the true center of the pavement.

EXPANSION JOINTS

The expansion joints were constructed by burying a 1-inch metal plate, similar in shape to the cross-section of the paving, about ½-inch below the surface of the paving and then pulling the plate after the finishing machine had passed over the joint. The joints were later filled with hot asphalt. Illustration No. 5 shows the metal plate in place and ready to have concrete poured around it. This method of constructing the joints was so successful that it is impossible to detect the location of a joint when driving over the pavement. The pavement was kept wet after laying

and covered with burlap until set up sufficiently to allow the spreading of calcium chloride for final curing.

PREPARING THE SUBGRADE

The subgrade was roughed in with teams and blade graders, pulled with crawler-type tractors. The excavation for side forms was accomplished with a Carr formgrader which excavated true to the grade set by a plumb line on the grade stakes. This machine can be so regulated that it will excavate a uniform distance below the plumb line. The final subgrading was done with the Lakewood subgrader pulled ahead of the mixer and the Koehring subgrader planer pulled just behind the mixer.

WIDENING AT CURVES

On all curves which required widening a false form was used to run the finishing machine on and this form was pulled just behind the finishing machine and the concrete all spaded together. Where considerable superelevation was used it was also necessary to replace the curved template on the finishing machine with a straight one, in order to get a uniform superelevation across the surface of the paving.

WORK ON SECTION C

The laying of Section C of this project was under the superintendence of Mr. Sparks, of the C. H. Atkinson Co., and is now also completed. This section was laid with about the same organization and equipment as used on Sections A and B except that they are using a 27-E Koehring mixer and an Ord finishing machine. This outfit did not move in until the middle of August, but had only approximately 8 miles of paving to lay. Although this paving gang was equipped with a larger mixer, they were never able to lay as much pavement in one day nor make such consistent records as the outfit on Sections A and B.

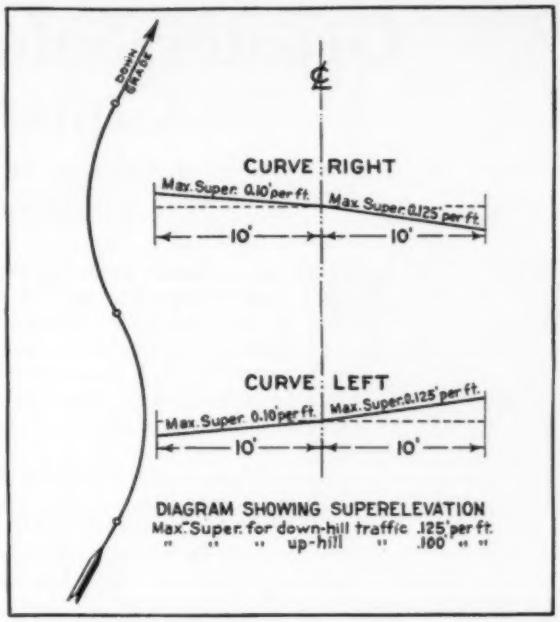
This might be explained by stating that the organization on Section C was not worked out to such a fine point nor did they have as well-balanced equipment as on Sections A and B. By balanced equipment we mean every piece of machinery loaded to capacity but none overloaded. For example, the 27-E mixer could mix more concrete than the finishing machine could finish if the materials could be gotten to the mixer.

Section C was finished on November 1, thus completing the 22-mile paving contract in less than five months. Considering the unfavorable weather conditions which existed during practically the entire job it might be concluded that the construction progress depends more upon the equipment and organization of the contractor than upon the weather or any other factors.

Features of New California Paving Construction

THE Mountain Springs Grade paving project, completed in June, 1927, is built to the highest standards of the California Highway Commission, according to *California Highways*. Constructed through solid rock in a difficult location, it is ranked by engineers as one of the outstanding jobs of 1927. The new highway extends from the Myers Creek bridge in Imperial County to the top of Mountain Springs Grade in San Diego County, a distance of 6.8 miles. It is near Jacumba, a resort at the top of the grade about 60 miles from El Centro.

The Jahn and Bressi Construction Co., Inc., is the contractor and began work in February, 1927. The paving is of portland cement concrete 20 feet wide, laid in two 10-foot strips, each 6 inches thick at the center and 9 inches at the edges. Considerable drilling and blasting was done ahead of the subgrade shaping to widen the roadway and improve the alignment. Making subgrade in the rocks was very expensive and the total cost of this job was $416,255.00. W. D. Eaton was Resident Engineer.



Plans for Superelevation on the Mountain Springs Paving Showing Variations in Superelevation at Center of Paving

Originally the road was a narrow grade, constructed by the two counties through public subscription. After being taken into the State Highway system, the easterly 5 miles was widened in 1920 under a day labor authorization. The westerly 1.8 miles was widened in 1926.

CONSTRUCTION FEATURES

Owing to maximum grades of 7.12 per cent and curves with radii as sharp as 140 feet, the matter of superelevation was given considerable study. Much of the traffic over this road is heavy trucking from the Imperial Valley to San Diego with slow uphill and fast downhill speeds and to care for this condition a compromised superelevation was adopted. Each one-half of the pavement was designed with different superelevation, suitable for the unusual difference in speed. Had the maximum superelevation been used of 2½ feet in the full 20-foot width there would have been danger of the heavy trucks with high loads overturning or sliding to the low side of the pavement.

Results obtained in the riding qualities of the finished pavement justify the type of construction adopted. In spite of the steep grades and sharp curves, motorists can drive with safety on either traffic lane.

Another feature worked out successfully in this job is a combination curb and guard rail. By thickening the curb and constructing it a few inches higher than the customary standard, it serves both purposes.

No hard and fast rules will insure safety on a construction job. This can be secured only by constant and careful attention on the part of the superintendent and foreman, with the cooperation of the workmen.

Greater Safety in Building Construction

By Robert D. Kohn, F. A. I. A.

Architect, New York City

PUBLIC clamor following any building construction accident or the discovery of reckless building methods in some community is always followed by a demand for more strict enforcement of the law or for the employment of a larger number of official building inspectors. But the building world knows that no amount of inspection or supervision by public officials will really be able to discover errors in structural design nor will the inspection of buildings in the course of construction prevent dangerous work from being installed by incompetent or intentionally reckless builders. We know perfectly well that safety depends on the person designing a piece of construction knowing how to design it properly and the contractor knowing how to build it right and wanting to built it right irrespective of inspection.

Our American habit of believing that it is the inalienable right of every citizen to make a fool of himself if he wants to has also protected any owner in his right to build almost any kind of a structure on his land provided that the designs for the building seem to comply with a set of rules called a Building Code, and the construction itself passes the inspection of an official who is probably a retired carpenter or mason, or a bartender whose former profession was put out of business by well-known Federal legislation. And, indeed, such inspection as is here referred to is only available in our cities and larger incorporated towns. In most states construction work outside of city limits can be done without the submission of plans to any authority and without any inspection whatsoever.

Not that official inspection of building construction is useless. Far from it! There is no doubt that the inspection in our larger cities is very good and many of the building superintendents and inspectors are trained men of great competence. But in the nature of things, the volume of building work going on in the average city is so great that it is absurd to assume that any really efficient protection is afforded the public by the small amount of time that the examiners can give to any one plan or the city inspectors to any one building. We are, therefore, face to face with a dangerous situation. The complexity of modern structures, the variety of new materials and methods constantly being adopted and the great variety of uses to which modern buildings are put, including great groups and assemblages, makes it very important that the responsibility for safe construction be placed squarely upon the person who initiates a building project, namely, the owner of the building. The responsibility must be put upon him to see that he engages a competent designer of his construction and a competent man to carry it out.

Following a series of building wrecks occurring in the East about three years ago a movement was started in the New York district to study this whole subject. A joint committee was formed representing various engineering and architectural bodies in the Greater New York region. The committee worked for many months and finally in 1925 produced The Report of the Joint Committee on Structural Safety, which is known to most of you. A copy of the recommendations of the committee will be attached to the printed version of this address. It summed up the situation by saying that safe building construction requires that adequate plans and specifications should be prepared for every building project; that the owner of a building should be the applicant for the building permit and should file adequate plans and specifications and that he, the owner, should be made responsible for the employment of competent persons to prepare those plans and specifications. The committee stated that in its opinion the employment of registered or licensed engineers and architects should be considered to be sufficient indication that the owner had hired properly qualified persons for the work, but that he should be required also to guarantee that the same architects or engineers or equally qualified persons should supervise the construction in his behalf, and see that the provisions of the law and the rules of safety be followed. It was the belief of the committee further that if an owner failed to take these steps he should be made legally and criminally responsible for any accident that might result by reason of the building operations which he had undertaken to have done.

Naturally, this report raised a good deal of discussion and the committee was more or less on the defensive, but its studies had included a survey of the whole situation in the building world. The committee had found that the public was unaware of the great change that had taken place in twenty years in the complexity of the building art. A quarter of a century ago buildings were comparatively simple and there were any number of contractors available who were well trained in the technique of building and fully able to carry out the ordinary construction of the day with safety. We still have good builders today, indeed, many very important well-organized contracting corporations capable of efficiently carrying on the immensely more important structures which now dot the landscape in every city. But the building world is endangered at the same time by many so-called builders without any training and with an enormous number of building concerns which are operated by financial administrators, without any knowledge of building and no interest in it, except as a means to getting a profit. A very large percentage of

the building work of the country is being done by individuals or corporations who are merely shopkeepers or traders in building. They buy so much brickwork or so much steel work or so much concrete work, awarding sub-contracts to anyone who will give the lowest price on a particular piece of work, although they themselves have very little or no knowledge of the technique of building and cannot tell good work from bad. In my own city an enormous amount of construction is done by so-called speculative builders using inadequate plans, amateur judgment in the selection of the "lumpers" who do each part of the work with no one actually supervising all of it. Under these circumstances, it is a wonder we have so few accidents. Aside from the danger to life we are producing a large number of buildings which will be run down and useless in twenty years. Some way must be found to block the plan of the reckless building owner to buy everything from carpenter work to engineering service from the lowest bidder.

Indeed, this is one of the big elements in the problem; the prevading rush after "cheap" construction. Price seems to be everything—quality hardly considered. Of course, our great business corporations know better. They build well and are willing to pay for good engineers, good architects and good contractors, but speculative builders have told me that they never considered quality in the operations in which they were so successful. Steel work was steel work, plastering was plastering, and architect's or engineer's services were bought like steel and plaster, at the lowest possible price. One such man told me that he was now helping his pet charitable institutions put up their buildings and now, he said, "Of course, I look at the thing in a different way. These institutions have to avoid big repair bills, so now I look sharply at quality and I am particular about the man who designs the building!" Of course, this new attitude is fortunate for the charitable institutions, but what about the people who own the other big buildings? Those he built to sell and not to keep.

Of course, contractors exist in all degrees of intelligence and honesty. Well intentioned contractors are liable to error in making estimated costs for a basis of proposals. Scientific and correct building is uncommon and the whole building industry suffers from errors. A contract which is based on a proposal less than cost is sure to fail. Under such conditions the contractor is continually seeking to find a cheaper method or material which will compensate for the error of a too low bid and prevent loss. Regardless of the high character and reliability of the contractor, it is only human for him to try to avoid loss. The cost of quality and workmanship is inescapable and there is no substitute for it. The building industry suffers more than any other industry from the competitive system if carried out consistently.

The outskirts of some of our cities are being built up with rows and rows of "Jerry-built" frame houses so badly built that the poor purchaser will spend more than the cost of the house in the course of ten years on repair bills and replacements. What are we going to do about this and all the other bad building that is going on?

Of course, we do find a rare owner who realizes that good work cannot be expected from a contractor who is losing money and that a bond will not help the situation. I have one client who has learned that lesson and recently he declined to award work to an otherwise competent and responsible contractor since his bid was evidently too low. But such people are rare.

In some countries ancient laws fix a liability upon the architect and the contractors for any financial loss that is incurred by reason of bad building. In France last year I heard of a case where a certain city sued an architect for having used bad floor construction in a hospital building. In the Province of Quebec in Canada, architects and contractors are jointly and severally responsible for failures in structures for five years after completion. While they do not seem to object to the fixing of responsibility, the architects do complain about their joint responsibility with the contractor since they maintain the contractors are generally selected by the client and generally on the basis of choosing the lowest bidder, and hence, a failure of the contractor should not be charged to the architect. Such a procedure would, moreover, be even more dangerous in this country when the contractors, in turn, frequently subcontract for steel work, for instance, totally ignoring the original design and leaving it to the steel contractor's designers to lay out some scheme intended to save money and for which the architect or original engineer could, of course, not be held responsible. Fortunately, in our most important practice in this country the old type free engineering service offered by contracting concerns is rapidly disappearing.

The answer seems to be in the recommendation to the committee that I have already referred to. We must make the owners realize that they are to be held by law responsible for the safety of the buildings which they have built. As they are not technical men them-

Governmental Control ad Absurdum

No one would think of requiring every physician who writes a prescription for a patient to submit that prescription to a city official before the patient is allowed to take the medicine and then have a man call once a week from the Board of Health to see that the nurse is giving the patient the medicine at the right time and shaking the bottle before serving. But to protect the public health the law requires that no one may prescribe for a patient without having passed such an examination as justifies the opinion that he will not endanger the lives of his patients and may actually do the patient good. While the immediate danger to a patient who follows the advice of an ignorant physician is guarded against, we still go on letting anyone design a building and anyone else build it and hope to avoid accidents by watching for infractions of the Building Code.

selves they will be relieved of responsibility the moment they put their building operation in charge of men who are recognized and obviously capable of building with safety. In just that way we require a father to engage a recognized physician to minister to his sick child. If he does not do so and the child dies, the parent is held criminally liable. In most states we have registration and licensing laws for engineers and architects. The situation can be simplified if we could secure such laws in all of the states. Then we could recommend the adoption of legislation similar to that proposed in the bill introduced in the Legislature of the State of New York in February, 1927 (fathered by the joint committee but not passed), in which owners of buildings are required to employ both for design and supervision a licensed structural engineer or a registered architect for any building operation other than one family houses and barns and farm buildings generally. (A copy of this bill is also attached to the printed record of this address.) Of course, legislation of this kind is going to be opposed violently by our speculative builders and by owners who do not want to be forced to pay for competent design and supervision. The bill introduced into the New York Legislature last year was not advanced for passage because of the opposition of a group of such owners and builders in one of the boroughs of New York City. They opposed the bill on the ground that it was merely a method of increasing the practice of architects and engineers. I doubt that that was their real objection.

This proposed legislation recognizes that it will not do merely to have designs made by competent engineers and architects; it will not do merely to have a competent person employed to watch the construction. The same person must be made responsible both for design and supervision, otherwise there will be no protection against the changes that are so frequently made in a design by someone trying to cheapen the cost. Two of the most serious wrecks in the eastern part of the country in recent years came about even though the original steel design of the structures was properly made. In one case the owner took a perfectly safe design and passed it over to a steel contractor who offered for a very low price to achieve the same result, that is to say, buiid a certain roof, with about half as much steel as was shown on the original drawings. The owner accepted this low estimate and the wreck resulted. The owner was incompetent to know nor did he care about the difference between the actual construction and the drawings filed in the City Building Department, and the city's inspectors did not discover the changes made when the great trusses were erected at the building site. So it is only by fixing the responsibility definitely upon the owner to employ a competent person to supervise the whole process of design and construction after designers and supervisors are registered and made responsible to the State that the risk of accident can be avoided.

ACKNOWLEDGMENT: From a paper read before the Fifth Annual Convention of the American Institute of Steel Construction.

Bravery in the construction industry needs only consist in the courage to institute a common sense safety program and the determination to carry out the program effectively.

Wellpoint Method for Excavation

FOR handling a rather delicate piece of excavation work for the foundation of the new sewage pumping station in Lynn, Mass., in the spring of 1927, the wellpoint method was used, according to an account in Vol. XIV, No. 7, Journal of the Boston Society of Civil Engineers by Prof. Charles Terzaghi. The work included an open excavation, 30 feet deep, through quicksand, at a short distance from both the seacoast and an incinerator plant with a rather shallow foundation. By using wellpoints for lowering the groundwater level, the contractor succeeded in keeping the quicksand almost perfectly undisturbed. As a result, at the bottom of the pit the quicksand was as firm as any well-compacted stratum of coarse sand.

The new pumping station covers an area of about 6,000 square feet, and the bottom of the foundation is about 30 feet below the original surface of the ground. The shortest distance between the building and the shore line of Lynn Harbor is about 100 feet, and the distance between the west front of the building and the municipal incinerator plant is about 55 feet. The incinerator plant rests on piles not more than about 15 feet long. Finally, when the pit was excavated, a channel had to be dredged for the outfall sewer, from the harbor toward the southeast corner of the pit, thus shortening the distance between the pit and the open water to about 40 feet.

From previous experience and from the results of laboratory tests, it was evident that the sand would turn into quicksand as soon as it was disturbed by local pumping. The effective size of the sand is about 0.1 mm., and the uniformity coefficient ranges between 1.9 and 2.3. A movement of the sand within and in the vicinity of the foundation pit would loosen the material, thus reducing its bearing capacity; it would endanger the incinerator plant; and finally it would have created the danger of an inrush of sea water from the bay into the pit, across the 40-foot ridge, which separates the open water from the pit.

STEEL SHEET PILING CONSIDERED

In order to prevent such accidents, two methods of excavation were considered: either to surround the pit by a row of steel sheet piling, driven through the sand to a depth of 2 or 3 feet into the clay, thus completely intercepting the seepage through the sand towards the pit; or to lower the groundwater level by pumping, prior to starting the excavation work.

FILL FIRST REMOVED

The contractor decided to employ the second method. He first excavated through the upper part of the underground which consisted of an artificial fill made out of earth and refuse, from elevation + 18 to elevation + 3.5 with an almost vertical slope, without any timbering. Then, close to the foot of the slope, they jetted into the ground a set of wellpoints about 12 feet long, 2 feet center to center, the lower end of the wellpoints being at an elevation —8. The wells consisted of 1½-inch steel pipes, provided with wellpoints. The last two feet of each well were perforated, a No. 70 brass mesh preventing the finer soil particles from getting into the pipes and clogging the wells. The wellpoints were connected by means of short sections of rubber hose, with a 6-inch manifold, completely surrounding the pit. From the main conduit the water was pumped by a 5-inch Gould centrifugal pump coupled with a 15-horsepower motor located at approximately the same level as the main. The discharge pipe emptied into a small wooden flume leading from the pit to the bay. A second pumping aggregate of the same type served as a reserve in the case of a breakdown of the first one.

GROUND WATER LOWERED BY WELLPOINTS

On account of the pumping the ground-water level went

down to about elevation —4 or —5, and the fine sand became firm and stable enough to permit the excavation to be carried out without any timbering, the material standing unsupported at a slope of 1:2.

After the material was excavated to elevation —2, a second set of wellpoints was jetted into the ground, connected with a 6-inch main and with two 6-inch Vortex pumps of which one (25-h.p. motor) was intended to be in operation while the other one (15-h.p. motor) was to serve as a reserve for emergency cases. This second set of wellpoints was in every respect similar to the first one, except for the fact that the lower end of the strainers was located at an elevation ranging between —14 and —16.

SUMP CONSTRUCTED

After having drained the sand by means of a second set of wellpoints, excavation continued to an elevation of about —9. At this elevation, however, water accumulated at the bottom of the pit, which indicated the presence of a continuous, rather impermeable layer separating from each other the spaces drained by the first and second set of wellpoints. In order to remedy the situation, a rectangular well 3 x 5 feet inside was constructed in one of the corners of the pit, bottom elevation —19. For this purpose a set of steel sheet piles was driven into the ground, completely surrounding the site selected for the pit. Then the material located within the enclosure was excavated. A lining made out of 4-mesh galvanized wire fabric stretched over a timber frame was lowered into the excavation, just fitting the inside of the sheet pile enclosure. Finally, the empty space was filled with pea gravel, serving as a filter, and the sheet piles were pulled. By draining the water from the bottom of the excavation towards the pit, and from the pit into the discharge flume by pumping with a centrifugal pump, the contractors succeeded in keeping the bottom sufficiently dry for finishing their excavation. They first reached the required grade of —12 in the section opposite the part which contained the square well.

WOOD SHEET PILES PREVENT CAVE-INS

Although the material stood at a slope of 1:2, even during the second part of the excavation, local cave-ins occurred, due to seepage water percolating out of the slope between the layers and seams of clay. Hence, the contractor had to protect the lower part of the slopes by means of wood sheet piles 5 feet long, driven to a depth of about 1 foot below grade by a small steam hammer.

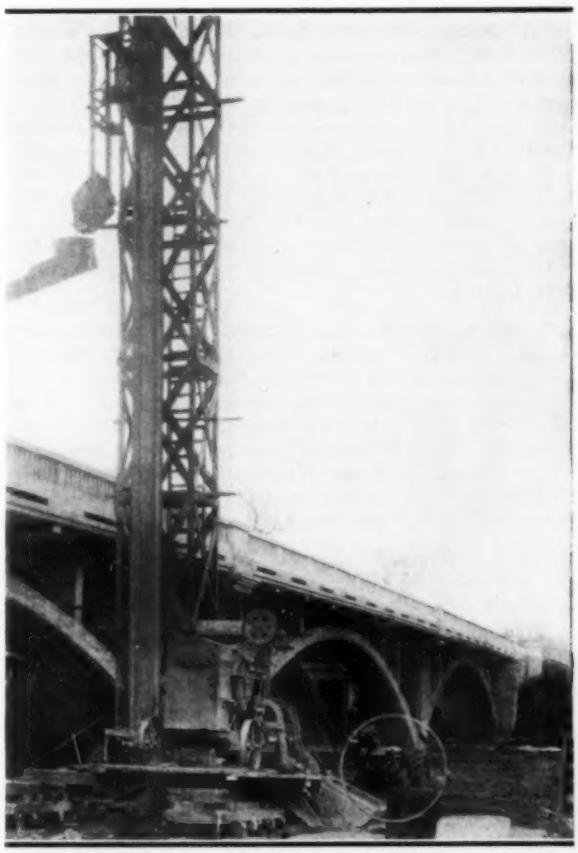
MOVABLE STEEL CAISSON USED

Finally, he built a 6-inch tile drain into the bottom covered by a 9-inch layer of gravel. The drain was laid outside the building line all around the edge of the bottom, with a connection across the bottom toward the square well. Since the lower end of the second set of wellpoints was located at a depth of not more than 2 or 4 feet below grade, no open excavation for the drains could be made at the bottom of the pit without the fine sand starting to flow. Hence, for placing the tile drain, the contractors used a rectangular steel frame, serving as a shallow, movable, open caisson. Under the protection of this steel enclosure the placing of the drain was carried out section by section, the frame being picked up by the derrick and moved forward to the new section as soon as the preceding one was placed.

LOADING TESTS

As a result of the combined effect of the wellpoints, the square well and the surface drainage, the underground remained practically undisturbed. Four loading tests were performed for the purpose of testing the relative resistance of the material. The tests were made by means of Watson-Stillman hydraulic jacks, bearing against a load of 10 tons resting on top of a primitive platform. The loaded area was equal to 1 square foot. One of the tests was made in a rectangular pit about 3 x 5 feet, 4 feet deep, the pressure acting in a horizontal sense against the smooth vertical walls of the test pit. The result of this test was practically the same as the result of the tests performed by exerting a vertical pressure on a horizontal surface of the same section of the underground. By means of these tests it was found that at elevation —12 the quicksand was exceedingly firm, a load of 5 tons producing a compression of not more than about 3/16-inch. At elevation + 2.0, the same load produced a compression of somewhat more than half an inch.

While the first (north) section of the excavation pit was prepared for placing the reinforcement, the second (south) section, including the square well and located next to the bay, was finished, the operations of driving the protective sheet piles, excavating and placing the drain following each other closely. This second part of the work was also accomplished without incident. During these operations, several wells became clogged, due to silt closing the openings of the wire mesh, or due to the particles being washed into the interior of the well and gradually filling up the lower part of the pipes. These wellpoints had to be pulled and cleaned. Morris Knowles, Inc., were the consulting engineers and The Tunnel Construction Co., (Spencer, White and Prentis, Inc.) the contractors. Charles Terzaghi, Associate Professor of Foundation Engineering, Massachusetts Institute of Technology, Cambridge, Mass., was retained by the consulting engineers for advising on the foundations of the pumping station.



A Porta Hoist at Work Elevating a Concrete Skip on a Bridge Over the Sac River in Greene County, Mo. This Bridge Consists of Three 100-foot Arch Spans Being Built by A. P. Poirot, Contractor of Belleville, Ill. The Porta Hoist Was Used in Driving Piling and Making Abutment Excavations as Well as for Elevating the Skip

Who's Who in Construction

A Series of Reports from Active Contractors Published Monthly

BUS. VOL.—ANNUAL VOLUME OF CONTRACTS
A—Over $5,000,000
B—Between $1,000,000 and $5,000,000
C—Between $500,000 and $1,000,000
D—Between $250,000 and $500,000
E—Under $250,000

M. A. Jenkins, Sacramento, Calif., 3560 Y Street. Organized October, 1926. Bus. vol. E. Started in construction work and contracting in 1896. Formed partnership with C. T. Wells in 1904, and operated under the firm name of Jenkins & Wells until 1917, when Mr. Wells withdrew to take up work in other fields. Operated under the same name, but as sole owner until 1921. In 1921 M. N. Elton entered the business, the firm being known as Jenkins & Elton until October, 1926. M. A. Jenkins is now carrying on the business alone. Major contracts: 1924, Bascule Highway Bridge over the Sacramento River at Isleton, Calif.; 1925, steel bridge with wooden trestle approaches over Bear River in Sutter and Yuba Counties, Calif.; 1926, Drawbridge, King Island, San Joaquin County, Calif.; 1927, reinforced concrete bridge over Cow Creek, Shasta County. Member: San Francisco Chapter of the A. G. C. of A.

J. F. Knapp, Stockton, Calif., 720 S. Aurora Street. Bus. vol. D. Major contracts: 1924, Garden Highway, 11 miles of concrete pavement and 7 miles of concrete pavement in Humboldt County for the State Highway Commission; 1925, 12 miles of concrete pavement in San Joaquin County for the State; 1926, State Fair Grounds Grandstand, for the State, and paving the streets of Berkeley. Calif.; 1927, 12 miles of concrete pavement and seawall work in Ventura County, for the State, and in 1927-28, 11 miles of pavement under construction in San Luis Obispo County, for the State. Member: San Francisco Branch, A. G. C. of A.

George A. Upham, Inc., Waterbury, Conn., 14 Sperry Street. Organized October, 1927. Bus. vol. E. The business has been carried on for the last thirty years as personal ownership under the name of George A. Upham. Officers: George A. Upham, President; Alfred E. Upham, Treasurer; Ethel E. Upham, Secretary. Major contracts: 1925, Southamayde Home, Waterbury, Conn.; 1927, Waterbury Medical Association, Colored Community House and Raymond Bakery, Waterbury, Conn. Member: A. G. C. of A.

Walter B. Avery, Washington, D. C., 632 G Street, N. W. Bus. vol. E. Major contracts: residence and commercial buildings.

The Richard Johnson Co., Hartford, Conn., 50 Trumbull Street. Organized March, 1924. Bus. vol. C. Has been in business continuously since 1900. From 1918 to 1924 the company operated as The Johnson-Wester Co., Inc. Since 1924 all building work has been carried on under the name of the present company, the same as before 1918, the firm of Johnson-Wester existing still only as a real estate holding company. Officers: Richard Johnson and G. R. Johnson. Major contracts: 1925, the West Hartford High School and the Lenox Theatre, Hartford; 1926, the Fern Street School and the Capitol National Bank, Hartford; 1927, the Wethersfield High School, the Chas. King Estate store building, and the Hartford Labor Temple, Hartford. Member: Associated Building Council of Hartford and A. G. C. of A.

Avery Brundage

Avery Brundage Co., Chicago, Ill., 110 So. Dearborn Street. Organized 1915, incorporated 1926. Bus. vol. A. Officers: Avery Brundage, President and Treasurer; D. L. Frasier, Vice-president; Joseph L. McNab, Secretary. Major contracts: 23rd Street Viaduct, Bridges in Grant Park, Ford Chicago plant, 2432 Lake View Avenue Apartment Building, 1448 Lake Shore Drive Apartment Building, 1540 Lake Shore Drive Apartment Building, 3500 Sheridan Road Apartment Building, 3520 Sheridan Road Apartment Building, 3800 Sheridan Road Apartment Building, Shoreland Hotel and Davis Hotel, Chicago, Ill.; Gary Hotel, Gary, Ind. Member: A. G. C. of A., Building Construction Employers Association and Builders Association of Chicago.

William Tamminga, Denver, Colo., 412 Tramway Building. Organized 1912. Bus. vol. D. Major contracts: general contract on the West High School, Denver, Colo.; Greeley High School, Greeley, Colo., and the Park Hill Junior High School, Denver, Colo. Member: A. G. C of A., and Denver Master Builders.

A. W. Blycher & Son, Bridgeport, Conn., 3142 Fairfield Avenue. Organized March, 1922. Bus. vol. E. Started in 1902, and the son entered the business in 1922. Officers: A. W. Blycher, President; Frederick Blycher, Treasurer. Major contracts: 1924, Black Rock Bowling Alleys; 1926, Dickson residence (masonry); 1927, Col. Carter residence (masonry). Member: Bridgeport Master Builders, and A. G. C. of A.

Chatfield Brothers, New Haven, Conn., 54 West Rock Avenue. Organized 1919. Incorporated January 1, 1928. Bus. vol. D. Officers: James H. Chatfield, President and Treasurer, and F. Grant Chatfield, Secretary. Member: New Haven Master Builders Association and New Haven Chapter of the A. G. C. of A.

F. W. Long & Co., Jacksonville, Fla., 1512 Barnett Bank Building. Organized 1910. Bus. vol. D. Major contracts: 56 miles in Alachua County, Fla.; 10 miles in Bradford and Clay Counties, Fla.; 10 miles in Georgia for the State Highway Department. Member: Florida Engineering Society, Florida Paving Contractors Association, and A. G. C. of A.

A. K. Adams & Co., Atlanta, Ga., 542 Plum Street. Organized 1923. Bus. vol. C. Arthur K. Adams was first interested in the firm of Hard & Adams, which was organized in 1919, this firm being changed to the Arthur K. Adams Co. in 1921. Officers: A. K. Adams, President; D. G. Cheatwood, Vice-president; C. M. Kennedy, Jr., Secretary and Treasurer. Major contracts: 1923, Canton Cotton Mills, Canton, Ga.; 1924, American Thread Co. plant, Dalton, Ga.; 1925, Georgia School of Technology Stadium, Atlanta, Ga., and 1334 N. Miami Avenue Corporation, Miami, Fla.; 1926, Sauquoit Spinning Mills, Gadsden, Ala., Seaboard Silk Mills, Elberton, Ga., and the Thomas Henry & Sons Mill, Nashville, Tenn.; 1927, Connecticut Mills Co. plant, Decatur, Ala., and the Dixie Mercerizing Co., Chattanooga, Tenn. Member A. G. C. of A., and General Contractors Association of Atlanta.

H. C. Turner

The Turner Construction Co., New York, 420 Lexington Avenue. Branch offices: Atlanta, Boston, Buffalo, Chicago and Philadelphia. Bus. Vol. A. Organized in 1902 under present name by Henry C. Turner, D. H. Dixon, and G. B. Horton, to operate under a license arrangement with the Ransome Concrete Co., and to sell a twisted steel bar in the New York territory. The first reinforced concrete contract outside of the New York Metropolitan District was in 1907, at which time the capitalization of the company was increased. Officers: Henry C. Turner, President; D. H. Dixon, Vice-president; E. J. Moore, T. A. Smith, and H. H. Fox, Vice-presidents, New York; A. C. Tozzer, Vice-president, Boston; J. P. H. Perry, Vice-President, Chicago; J. C. Andrews, Treasurer; A. W. Chapman, Secretary. Major contracts: 1925, factory buildings for F. G. Shattuck Co., New York, and Western Electric Co., Kearny, N. J.; stadium for University of Pittsburgh, Pittsburgh, Pa.; municipal stadium, Philadelphia, Pa.; Dennis Hotel, Atlantic City, N. J.; 1926, office building for Florida East Coast Railroad, Miami, Fla.; home office buildings for the Massachusetts Mutual Life Insurance Co., Springfield, Mass., and the Fidelity Mutual Life Insurance Co., Philadelphia, Pa.; the Breakers Hotel, Palm Beach, Fla.; factory for the General Electric Co., Philadelphia, Pa.; Sesqui-Centennial Buildings, Philadelphia, Pa.; Green Terminal Building, New York; 1927, factory building for the Otis Elevator Co., Yonkers, N. Y.; factory buildings for the Western Electric Co., Hawthorne Works, Chicago, Ill.; publishing plant, Hearst Publications, Inc., New York; office buildings for the Provident Trust Co., Philadelphia, Pa.; New York Telephone Co., Newark, N. J.; Provident Mutual Life Insurance Co., Philadelphia, Pa.; vehicular bridge and roadways for the James River Bridge Corp., Newport News, Va. Member, Associated General Contractors of America, Architectural League of New York, Chamber of Commerce of New York State, Chamber of Commerce of the United States, Merchants Association of New York, New York Building Congress, Fifth Avenue Association.

D. H. Dixon

Maas-Manson Co., Chicago, Ill., 241 E. Ohio Street. Organized September, 1924. Bus. vol. E. This is a partnership, and composed of the members of the old E. V. Johnson Co. Mr. Johnson, the President, and Walter E. Maas, of the partnership, were associated in the company, and were also connected with the National Fire Proofing Co. from 1910 to 1915, when the E. V. Johnson Co. was formed. The present partnership was formed at the death of Mr. Johnson, with William R. Manson, Engineer for the E. V. Johnson Co., and Walter E. Maas. Major contracts: 1924, Illinois Merchants Bank Building (partitions); 1925, High Noon Club of Chicago, Stambaugh Memorial Building, Youngstown, Ohio, Surf Apartment Hotel Addition, Chicago, Ill., 82nd and Bishop School for Board of Education, and 78th and Prairie Avenue School for Board of Education; 1926, Elizabeth Arden Apartment, Chicago; 1927, K. of P. National Temple Building, Chicago. Member: Builders Association of Chicago, and Building Construction Employers Association and constituent bodies.

Jerome A. Moss, Chicago, Ill., 80 E. Jackson Street. Organized July, 1920. Bus. vol. C. Major contracts: constructing buildings for various railroads and fruit terminal buildings for Santa Fe, Chicago. Member: A. G. C. of A.

Southern Ferro Concrete Co., Atlanta, Ga., 70 Ellis Street, N. E. Organized March, 1905. Bus. vol. B. Officers: Charles Loridans, President; H. W. Beers, Vice-president; E. J. Coppedge, Secretary and Treasurer; J. P. Wey, Assistant to President. Major contracts: 1925, Andrew Jackson Hotel, Nashville, Tenn., Carling Hotel, Jacksonville, Fla., Municipal Auditorium, Macon, Ga., First National Bank, Tampa, Fla.; 1926, Halifax District Hospital, Daytona Beach, Fla., Daniel Ashley Hotel, Valdusta, Ga., Archbold Memorial Hospital, Thomasville, Ga.; 1927, University of Virginia Medical School, Charlottesville, Va., and Wesleyan College, Macon, Ga. Member: A. G. C. of A., Atlanta Bldrs. Exch., and Atlanta Contractors Assn.

Morrison-Knudsen Co., Boise, Idaho, 302 Broadway. Branch offices: Old National Bank Building, Spokane, Wash., and Continental Bank Building, Salt Lake City, Utah. Organized March, 1912. Bus. vol. B. Organized as a partnership in 1912, incorporated in 1923. Officers: M. H. Knudsen, President; H. W. Morrison, Vice-president and General Manager; C. W. Joslyn, Secretary and Treasurer. Major contracts: grading, track laying, tunnel work, etc., for railroads, heavy highway grading projects, construction of irrigation and drainage projects. Member: A. G. C. of A.

Kirschner Bros., Erie, Pa., 433 East 9th Street. Organized 1890. Bus. vol. D. S. Kirschner established the business, and at his death his sons, George E. and Joseph F. Kirschner continued the business as partners. Major contracts: 1925, residences in Erie, Pa. of Chas. Mertens and F. W. Nick; 1926, Gamon Hall, and Our Lady's Chapel, Erie, Pa.; 1927, St. John's Kanty College, Erie, Pa., and Rice Avenue Union High School, Girard, Pa. Member A. G. C. of A., Builders Exch., Erie Chamber of Commerce.

Brown & Mick, Inc., Indianapolis, Ind., 226 East Michigan Street. Organized March, 1924. Bus. vol. D. Officers: E. H. Brown, President; Wm. E. Mick, Secretary-Treasurer. Major contracts: Crispus Attucks High School, Indiana School for the Blind, J. I. Holcomb residence, Thornburg Lewis Motor Co., and Eli Lilly Co., garage and barns, all in Indianapolis, Ind. Member A. G. C. of A. and American Concrete Institute.

Ernest M. Ganley Co., Inc., Minneapolis, Minn., 2922 Oakland Avenue. Organized February 5, 1917. Bus. vol. D. This company was organized in 1908 as the E. M. Ganley Construction Co., to specialize in concrete work such as bridges, paving, sidewalks, and reinforced concrete for buildings. After its incorporation the business became general contracting in addition to specializing in concrete work. Officers: Ernest M. Ganley, President. Major contracts: 1923, paving 4 miles of Rice Street; 1924, building 3 spans of Grays Bay Bridge; 1925, building St. Thomas School and Auditorium; 1926, building Naflalin Apartment and store building, and building the Ke Hawke Mfg. Co. factory. Member A. G. C. of A.

Ernest M. Ganley

Stanton & Wallace, Arkansas City, Kansas. Branch offices: Newton, Kans., Dalhart, Tex., and NewKirk, Okla. Organized July 1, 1921. Bus. vol. B. This company was the Stanton Construction Co. from 1917 to 1921, when the present partnership was formed. Officers: James Stanton, Sr. and Thomas Wallace, partners. Major contracts: 1917-1927, municipal projects for Arkansas City; 1923-1927, municipal projects for Newton, Kans.; 1926-1927, projects in Dalhart, Texas, and municipal projects in Tampa, Florida; 1927, Projects 1 and 3 in Kay Co., Okla. Member: Associated General Contractors, Kans. and Mo. Contractors Assn., and Western Contractors.

Hot Mix Plant Layout

Duplicate Plant Built for State Highway Bituminous Concrete Projects Near Chatham on Cape Cod

FOR many years the State Highway Department of Massachusetts has used hot mix for the greater part of its Cape Cod work. This has led to the gathering of a group of contractors highly proficient in this kind of work and who have developed economical and efficient hot mix plants. The plant described below was built early in the 1927 construction season to supply material for a section of State Highway No. 28, which carries an increasing traffic each year from all parts of North America to the narrow peninsula of Cape Cod at the tip of which the Puritan Fathers first set foot on the continent of the West. The artist colony at Provincetown also probably has its interests for many who make the pilgrimage. The plant of The Lane Construction Corporation of Meriden, Conn., was later used to furnish a hot mix for a section of the northern route along the Massachusetts Bay side of the Cape.

The plant is located in a slight depression off the relocated road between Harwichport and Chatham. Both stone dust from the Lane Corporation's quarries at Meriden and Westfield, Conn., and the Socony asphalt come in on a spur track at the north of the plant at an elevation of about 40 feet above the final delivery point to the mixed material. The stone dust is dumped from the gondola cars to a pit below from which it is removed by a Burch unloader and a belt conveyor run by a Fordson tractor and loaded into 2-ton trucks. These trucks run a short distance to the edge of the sand pit and dump the stone dust into a storage pile over a bucket conveyor.

The asphalt tank cars are spotted about 100 feet beyond the stone dust cars on a second track. This makes it possible to handle the three cars of stone dust that can easily be unloaded each day by two men and the mechanical equipment or to move the asphalt tank car out without delay without either disturbing the other operation. The tank cars are heated in the usual manner by steam furnished by an old horizontal boiler which also runs the Kinney asphalt pump. The pump can unload a standard Socony tank car in one day when operating at maximum capacity. The asphalt is pumped to the storage tanks of the duplicate Cummer asphalt plants in the pit below.

Sand Production

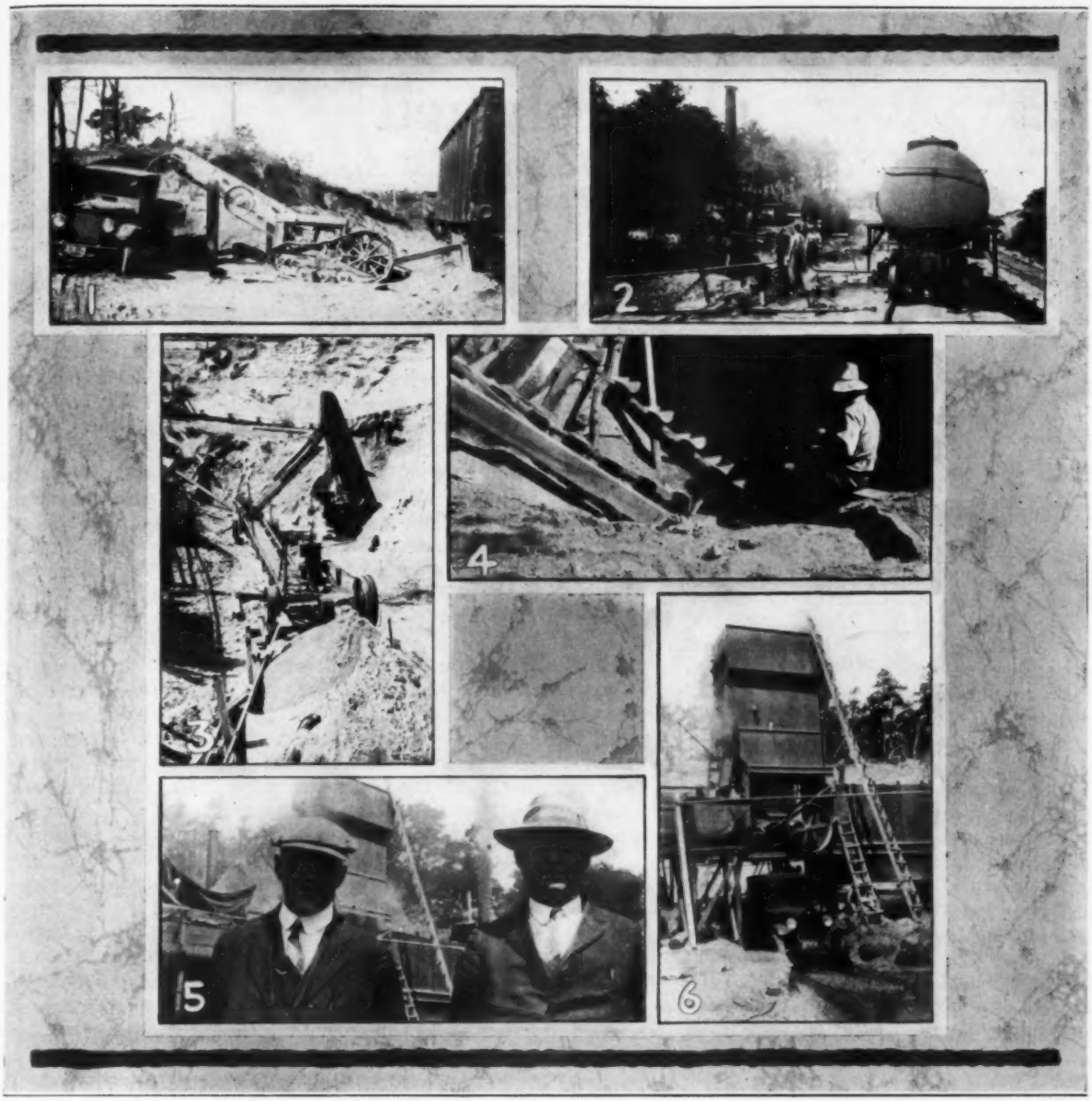
An ingenious use of old equipment in the sand pit has produced a very flexible conveying system that minimizes the moves of the mixing plant proper. A Nelson bucket loader operates at the end of the line and is supplied with ample quantities of sand from the bank by one man who starts small slides of sand from the face of the bank toward the loader with a scoop. An old Koehring aggregate loader about 50 feet long is used to convey the sand horizontally to a storage pile near the mixer plant. A bucket loader carries the sand from the bottom of the storage pile to the drying drums of the plant.

The Hot Mix Plant

The Cummer road asphalt plant has two bucket elevators to convey stone dust and sand to the dryer. The rotary dryer consists of a cylinder into which the wet sand is fed through a spout where it is met by a blast of hot dry air from the first hood and as it travels toward the discharge end is met by fresh blasts of hot dry air from each succeeding hood. Because of the fact that the material entering the drying cylinder is wet and cold, the heated end of the first hood quickly becomes saturated with moisture and loses its heat which is drawn out by the fan. The drying cylinder is designed so that the material will be warm and also dry before it passes the last heat inlet. The material then passes rearward into the flame from the rear oil combustion chamber. The material is then stored in the bins and emptied into buckets, weighed and dumped into the mixing devices for discharge to the trucks below.

The capacity of the larger single plant is 250 tons of hot mix top per day and the smaller, which was used when the work was at a peak or the larger plant was out of service, has a capacity of 175 tons per day. The mix produced is in accordance with

Typical Scene on the Chatham-Harwich State Highway on Cape Cod Built by the Lane Construction Corporation of Meriden, Conn. Photo by H. E. Warren, State Resident Engineer, Taken Shortly After the Seal Coat Had Been Put On.



SCENES AT THE CHATHAM HOT MIX PLANT OF THE LANE CONSTRUCTION CORP.

1. Burch unloader with Trackson-equipped Fordson unloading stone dust from gondola car. 2. Kinney steam pump unloading Socony asphalt from tank car on siding above the mixing plant. 3. Combination of Nelson loader, and Koehring conveyor handling sand from bank to stock pile. 4. Bucket loader handling stone dust from stock pile to the dryer of the Cummer asphalt plant. 5. At left, Henry Warren, Resident Engineer, and at right, H. C. Holden, District Engineer, Massachusetts State Highway Department. 6. Storage bin for dried sand and stone dust in Cummer plant. Note the dump body mounted at the left to receive over-size material. When filled this is tipped into a dump truck and taken out to fill on shoulders.

the Massachusetts State Highway Department specifications for Type-A bituminous macadam and is roughly 30 per cent stone screening, 64 per cent sand and 6 per cent asphalt. Graham and Reo trucks were used exclusively for hauling the hot mix to the road.

Henry Warren was Resident Engineer for the State on this job. A. C. "Chuck" Woodhouse, the Cape Superintendent of the Lane Construction Corporation, who has been with that company sixteen years, was personally responsible for the plant layout described above.

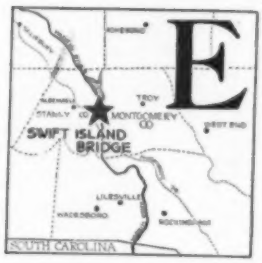
Longest Continuous Stretch of Concrete Road Is in Minnesota

THE longest continuous stretch of concrete highway in the world was completed late in 1927 between White Bear and Duluth, Minn. This pavement passes through 29 towns and villages over its 137-mile length.

Paving construction on this thoroughfare, Minnesota State Trunk Highway No. 1, was begun in 1923. This Minnesota pavement is two miles longer than the concrete pavement extending from Olympia to Vancouver, Wash. The third longest stretch of concrete rural pavement reaches from Kansas City to a point west of Columbus, Mo., a distance of 125 miles.

5-Year-Old Concrete Bridge Demolished

Carolina Power Dam to Flood Structure So Bridge Is Tested for Strength and Destroyed by Bombing



ENGINEERS and contractors who have built and are building concrete bridges will have their faith in this type of structure increased to an even greater extent by studying the account of the recent attempt to test to destruction the 1100-foot, multiple-arch, reinforced concrete bridge over the Yadkin River in North Carolina. The value of careful concrete work in bridge construction was demonstrated and the great strength of the open spandrel concrete arch shown in these tests.

The bridge, built in 1922 at a cost of $250,000 by the Cornell-Young Co. of Macon, Georgia, had to be replaced because construction of a dam by the Carolina Light and Power Co., a few miles below it, backed water up over the roadway. Although as good as new, the bridge had to be abandoned and a new span erected at a point farther up the river.

This afforded a splendid opportunity to test the strength of a concrete bridge and learn how the theory of concrete arch design checks out in actual practice. The North Carolina Highway Commission and the U. S. Bureau of Roads decided to carry out a series of tests with the cooperation of leading technical societies such as the A. S. C. E., the A. S. T. M., A. C. I., A. B. E. A., the U. S. Bureau of Standards and the Highway Research Board. Theories which, until this time, could be tried out only on miniature models were here tested on a full size, well constructed, concrete bridge.

Loading for Test

The engineers planned to test the bridge to ultimate destruction by loading the central arch with enormous water tanks which could be filled with water until the arch collapsed. This central arch, as well as the two arches on either side of it, was 150 feet long. They were led up to by 14 deck girder spans, each 40 feet long. Two movable wooden tanks were constructed, weighing 47,000 pounds each, and these were placed on the central arch where they could exert a load of approximately 700,000 pounds.

Structure Withstands Test Loads

Although the bridge was to have been tested to destruction, it never was, because the concrete arch did not collapse under the maximum load that could be applied with the equipment. Two exhaustive series of tests were conducted, the first with the structure just as it stood when open to traffic, and the second with the continuity of the structure destroyed by removal of sections of the superstructure, or flooring, to prevent distribution of strain. At the end of the tests the bridge still stood up despite the loads placed upon it.

Bombing Demolishes Bridge

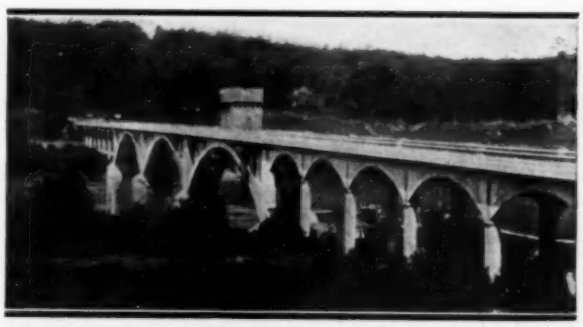
To accomplish complete destruction of the bridge and remove it as an obstruction to the reservoir, the U. S. War Department decided to test the effectiveness of its airplane bombing fleet upon it. Eighteen planes carrying high power bombs were sent out from Fort Bragg, December 23, and they dropped bombs upon the structure until it was completely demolished. It was found that 600-pound bombs were inadequate to destroy a concrete bridge of this type and heavy bombing with the large 1100-pound bombs was necessary.

Measuring Effect of Test Loads

Remarkable strength was shown by the structure in resisting the loads placed upon it in the series of tests conducted before the bombing. In the first phase of the loading tests, a complete series of loads was applied along the upper deck at different panel points. Twenty-four Cartridge Telemeter gages installed at different points along the top and bottom of the ribs measured the deformation stress. Other instruments measured rotation movement and vertical movement. It was found that a crown load of 160 tons produced a deflection of only $\frac{3}{8}$ inch. At the conclusion of the first series of tests no damage was apparent other than the development of surface cracks on the under side of the arch.

Before the second part of the testing was started, the superstructure of the bridge was cut through transversely at 13 panel points to eliminate any support the upper portion might give to the arch through a truss effect. Thus the final series of tests were conducted on a rib approximating a perfectly independent single arch design.

The final tests showed that the concrete span was able to withstand an enormously greater load than that



The Swift Island Bridge Over the Yadkin River Showing the Water Tank in Place for Loading the Central Arch

Central 150-foot Arch of the Swift Island Bridge Which Was Subjected to a Load of 345 Tons Without Failure. The Falsework Underneath the Span Was Put Up to Hold the Observers as the Tests Were Conducted

for which it had been designed. The maximum load put upon the arch was 345 tons, applied at four roller contact points. The arch did not fail under this excessive load, although designed to carry a live load of only 125 pounds per square foot. This performance demonstrates the adaptability of the reinforced concrete arch to bridge construction of all kinds, and shows that spans of much greater length than are now being built are practicable. It is estimated that the load of 345 tons produced a compressive stress in the concrete of more than 3,000 pounds per square inch.

VALUE OF CLEAN AGGREGATE SHOWN IN TESTS

The fact that the Cornell-Young Co. used good clean local aggregates and a standard quality of domestic portland cement is pointed out as proof that contractors can turn out excellent quality concrete with ordinary materials. The business of concrete making has been so improved by contractors and builders that the structures they put up are more than able to stand up under the loads for which they were designed. That is, improvement in concrete making by the men who actually place the "mud" has increased the factor of safety in concrete structures far beyond design requirements. A mix of 1:2:4 was used with coarse aggregate consisting of local crushed stone and fine aggregate shipped in from dealers in the neighboring towns of Lilesville and West End, North Carolina.

One of the chief reasons for the growing confidence in concrete bridges, both small and large, is that contractors and builders are making cleaner, stronger and better concrete. Selection of sound aggregates, careful batching and supervision of mixing and placing is resulting in better concrete in all types of structures. The Yadkin River bridge tests demonstrate what many engineers and designers have felt for some time is an important fact,—that the full strength of concrete is not being utilized in many of our present structures. It should be possible, with the present quality of concrete, to construct much longer arch bridges. A Frenchman, Freyssinet, has figured that with his method of rib compensation it is possible to build plain concrete arches of 1000-foot span, and reinforced concrete arches of 2000-foot span, using mild steel reinforcing. Europe has outstripped America in its forward progress in concrete arch construction.

FORM CONSTRUCTION

Knowledge of form construction is one of the most important factors in good bridge construction. A carpenter foreman who can read blueprints understandingly and transfer the data into strong forms that will not bulge out of alignment or move under the weight of tons of concrete is the most valuable assistant a contractor can have. Expertness in form building is developing among a class of carpenters, which is doing a lot to reduce the contractors' and builders' problems in concrete work.

ELASTICITY OF CONCRETE

An interesting point in connection with these bridge tests is that the concrete showed an unexpectedly high degree of elasticity. The construction joints at the spring points of the arch ribs showed a very evident widening as the test load was increased to the maximum. When relieved at the load, however, the construction joints regained their original true contacts without apparent injurious effects to the concrete members involved.

Concrete test cores taken from the piers of the bridge show that a very good quality of concrete was placed by the contractor. The 1:2:4 mix produced a compressive strength concrete of 4600 pounds per square inch.

HISTORY OF STRUCTURE

The bridge was begun by the Cornell-Young Co. in October, 1920, and was completed January 9, 1922. The three central arches, 150 feet each, are of the open spandrel type, ribbed, with a 28-foot 3-inch rise. The bridge was built as part of Highway 74, by the North Carolina State Highway Commission, with the aid of the U. S. Government under the Federal Aid plan. The remarkable fact that the bridge did not fail under the maximum load applied by means of the tanks indicates the soundness of its construction. The final destruction of the structure with army bombing airplanes was a dramatic scene which attracted much attention throughout the country and was of considerable value to the War Department in indicating the resistance of concrete bridges to aerial attack.

An Underwood & Underwood Picture Showing a U. S. Air Corps Bomb Striking the Swift Island Bridge

Contract 2373

Massachusetts Tries Out Curing With Calcium Chloride for First Time

TEMPTATION to rush with new ideas ahead of the next engineer and to use radical methods even before they have had sufficient test on trial roads and sections is great. Massachusetts has never been called radical as regards its state road work, rather the opposite, for not infrequently she has been called too conservative in the construction of concrete roads. The answer is found in the attention that has been given to the development of high grade bituminous roads which abound in the confines of the Bay State. This article deals with a new step that was taken during the last construction season by the State Highway Department in permitting curing of concrete roads by calcium chloride surface treatment. Contract 2373 at Swansea, Mass., on the road between Providence, R. I. and Fall River, Mass., marked the first project under these specifications and the New Bedford-Fall River work at Westport, described in the January issue of CONTRACTORS AND ENGINEERS MONTHLY is another of the 1927 construction season.

Contract 2373, on which Joseph McCormick of East Providence, R. I., was the contractor, called for the construction of 2.8 miles of 20-foot concrete road of a 1:2:3½ mix, 8 inches thick and with 3-foot macadam shoulders. The road was built on a 12-inch gravel subbase. Elastite expansion joint was used every 55 feet. The gravel subbase was rolled to final grade with a Buffalo-Springfield tandem roller and a 3-wheel 12-ton roller.

A MultiFoote paver with boom and bucket, and a pipe drag to support the reinforcing, was used throughout the job. The old mix of 1:2:4 was changed this year as noted above, and a half bag of lime, also used in 1926, was added to each batch to increase its workability. An Ord finisher followed the paver closely, screeding the plastic mass to an even surface. Before the initial set the surface was given a hand-belting by two men one on either side of the road. Following this the upper edges were rounded with finishing tools from bridges and then frames covered with muslin were set up over the section for 24 hours. On the early section of the job, earth curing was used but over 90 per cent of the job was cured with 2 pounds of Solvay calcium chloride per square yard spread by one man using a Solvay chloride spreader. It was found easy for one man to spread the entire work of a day in a couple of hours. When earth cover was used it was required that the contractor hire one man to spread and sprinkle each 2000 yards of 2-inch earth cover. Another saving of considerable importance in calcium chloride curing as compared to earth cover is the amount of water required under the earth-cover specifications. It put a severe strain on the pipe lines to supply the paver and also the hoses used for sprinkling. In too many cases in the past the sprinkling has suffered to the detriment of the curing of the surface.

The principal objection of the Massachusetts highway authorities to the use of calcium chloride was the difficulty experienced by the contractors in keeping the obstreperous motorist off a road that was clear of such continuous obstructions as are readily supplied by the earth cover with plenty of one-man stones scattered about. Adequate policing and more sturdy barriers seem to be the solution of this difficulty.

USE OF DOWELS

Adjacent sections of the pavement both longitudinally and laterally are doweled, the longitudinal joints with ½-inch deformed bars, and the transverse joints with -inch plain bars. The contractor prior to 1927 kept one man busy wrapping these dowels more or less securely with newspaper to prevent adhesion of the concrete. The superintendent has cut this expense greatly by using cardboard mailing tubes over the rods at a cost of one cent per tube. The job is neater, more secure and cheaper.

TRANSPORTATION OF AGGREGATE

Aggregate from the Seekonk gravel pit of Joseph McCormick was hauled to the job, a round trip of 6 miles, and the cement picked up en route at a junction of the main road with a secondary road leading to the railroad siding where the cement cars were run in. The half bag of lime was thrown onto each of the four batches at the same time that the bags of cement were loaded. The cement was emptied when the trucks reached the site of the pouring, thus preventing the blowing of a considerable portion of the cement into the landscape. The bags were dropped in one general locality and were picked up and loaded into one truck near the end of the work day.

WATER SUPPLY

The water supply for this job was located near the easterly end of the work and was pumped from the stream to the paver by an old American-LaFrance steam fire engine of a very early vintage.

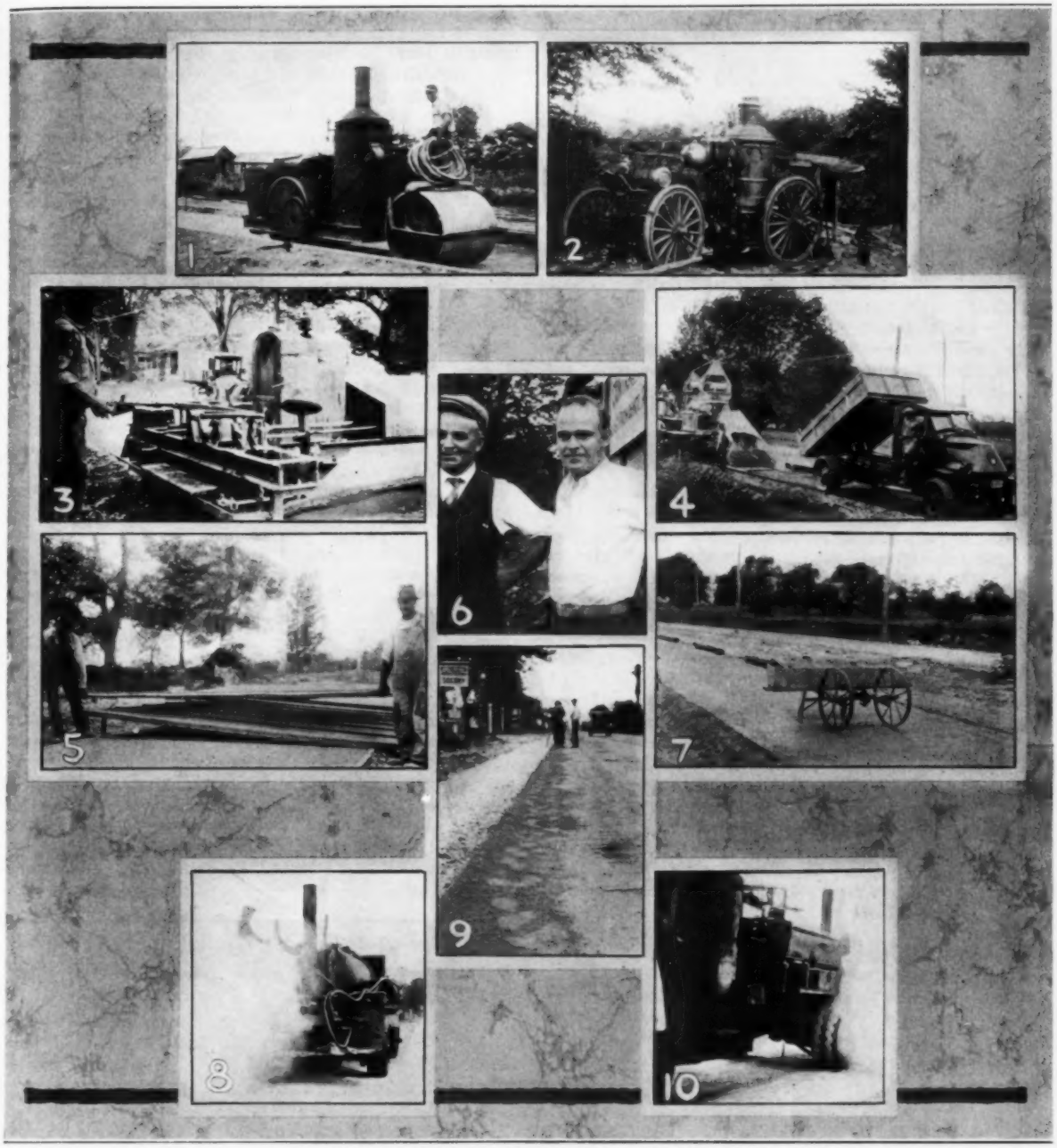
FINISHING SHOULDERS

The 3-foot macadam shoulders, after being rolled, were treated with Socony asphalt from a distributor In order to prevent the asphalt spattering or running onto the pavement, sand was spread on the concrete for about 15 inches from the edge. When the distributor had passed, this sand was swept onto the treated shoulder and acted as a blotter and filler.

USE OF PIPE DRAG

Relative to the use of the pipe drag supporting the

steel reinforcing on this job, this pipe drag was chained to the mixer, and as the mixer advanced the drag was advanced, allowing the concrete to get down under the steel, and keeping the steel a few inches from the bottom of the slab. When the mixer was stopped for any length of time, the pipe drag had to be pulled out. If this had not been done, the concrete would have taken its initial set, and would not have filled the space left by the pipes when the drag was pulled ahead. This would leave a large void in the concrete where each of the pipes rested. The drag consists of three 1½-inch cast iron pipes, about 10 feet long, laid longitudinally.



SCENES ON THE SWANSEA JOB OF J. McCORMICK OF EAST PROVIDENCE, R. I.

1. Buffalo-Springfield steam tandem roller which worked on the final subgrade. 2. An old American-LaFrance steam fire engine pumping water for the mixer and for curing that portion of the road where the earth and straw cover method was used. 3. The Ord concrete finisher. 4. One of the fleet of Mack trucks delivering a batch to the MultiFoote paver. 5. Protecting the concrete for the first 24 hours with muslin covered frames prior to earth cover. 6. At left, William Donovan, Resident Engineer, Massachusetts State Highway Department, and, at right, C. Weller, Assistant Engineer. 7. Solvay calcium chloride spreader which was used on a portion of this contract, this being the first Massachusetts State Highway contract cured with calcium chloride. 8. Rear view of Socony road asphalt distributor spraying the shoulder along this concrete highway. 9. Sand spread along the edge of the concrete strip to protect it from the asphalt which might be spattered when the distributor applied the asphalt to the penetration shoulder. The sand was later swept over on to the shoulder to act as a filler. 10. Side view of the Socony asphalt distributor.

Grand Strategy in the Building Industry

REPRESENTING the general public of the State of New York on the State Industrial Survey Commission, James W. Gerard, Ex-ambassador to Germany and a former Supreme Court Judge, recently told the New York Building Congress that the general public looks for stabilization of building costs through the cooperation of all elements in the industry. The Commission, Ambassador Gerard said, included in its work last year the revision of many of the laws concerning Workmen's Compensation. This body recommended to the legislature the adoption of the 48-hour working law for women which was passed by the legislature and signed by the Governor and now is a law of the State.

THE EVIL OF CLOSED UNIONS

"During the time in which we have been in session, we have had the benefit of consultations with the labor leaders. We have endeavored to settle many disputes such, for example, as the question of closed unions because we found that some of the unions were practically closed. And I think I may say that by negotiations we were able to induce the leaders of those particular unions to increase their membership.

"Of course, closed unions would become a menace not only to capital, but to labor in creating an aristocracy of labor, of men obtaining enormous pay and continual work, while employers were crying for more men in the same line of work, and working men without jobs were walking the streets of the city unable to obtain admission to these unions.

"Unions are a necessity, as anyone knows who will study the labor legislation of labor conditions as they existed, for instance, at the beginning of the last century in England, and by reading the reports of the Lord Shaftsbury Commission that inquired into the deplorable conditions where children, ten and twelve years old, took the places of mine ponies to draw the carts or sat at the gates to open the air passages for the miners, working perhaps sixteen hours a day and sitting in the dark. These conditions have had their results in the labor situations in that country today.

"The use of the unions brought up the working men, brought them to their present condition and no one in this country wants to see wages reduced, or wants to see any change in our present condition. We are interested in seeing that the people at large have homes—a decent place to live. And it is obvious that if a man buys a lot for $1500 in Long Island City, or in any of our suburbs where people are now compelled to go if they want to bring up their children decently and spend ten or fifteen thousand dollars for a house, the increase in the cost of building is a very large one—a large increase in the total percentage of this cost.

WASTE IN THE BUILDING INDUSTRY

"What is apparent to the people is the great waste in the building industry. Jurisdictional disputes produce this waste. A jurisdictional dispute is a strike not against the employer in the first sense although he is injured just as much as if it were a strike for a higher wage. The man who is having the building built, the contractor, stands there with the money in his hands ready to pay high wages and have the work done. But there is a dispute between two branches of working men, each claiming the right to perform a certain kind of work, and in the meantime the operation is held up. A building like a hotel is compelled to go on after the end of the strike, paying an enormous premium in the shape of extra wages beyond the usual hours of labor in order to finish the hotel in time for occupancy in the autumn. That is where there is the most tremendous waste in the building industry today.

"No matter how industrious you may be, no matter how well the working man may work in your units, if there is a fault in generalship, a fault in grand strategy, your whole industry is injured, not only injured immediately, but injured in the eyes of the public who consider that this is a most expensive and useless waste.

JURISDICTIONAL STRIKES AN ABOMINATION

"I can say with authority that the great labor leaders of this country are not in favor of jurisdictional strikes. They are opposed to them. They are not against the use of new materials that may cheapen building. They recognize that all those things are advances toward the five-day week, the time when labor is so efficient and capital so well applied that two days a week of rest may be given to the whole of the population. They recognize that. They are not opposed to it. But there are continual examples cropping up. For instance, last summer, they were building a high school in this city and it was held up by one of these jurisdictional strikes. The plasterers' scaffolds were built by plasterers' laborers. Immediately the carpenters went on strike. And at the same time, there was another jurisdictional strike in a building on Madison Avenue, New York, because there the carpenters built the scaffolding for the plasterers and the plasterers and their laborers went on strike on that account. In each case there was a tremendous loss.

"Cases such as these affect the laboring man just as much as anyone else. It all comes back on the general public and that is why the general public is intensely interested in disputes of this kind. We have found, not only on the side of labor, that is in the lower unit, but those in command of labor, the labor leaders, are against this. We have found among the contractors a little evidence now and then of combination.

"We had the actual testimony before us of a plumbing contractor who said that once a building had a plumbing contractor in, no other plumbing contractor will touch it or bid. I don't know to how many others of your trade that applies. It means that if a man finds he wants to add to his building, or his plumbing, he can't call in bids from other people. He can't have fair bidding to get the lowest bidder, but has to give it to the man already at work at any price that man chooses to ask him. That is not exactly fair to the general public. And between capital and labor, if you don't find a way to end these abuses you are going to, by these faults of grand strategy, injure your businesses in the eyes of the public. You are going to injure yourselves in the diminution of the volume of business which will come to your trade and I beg of you, capital and labor both, to so join, to so compose your differences that these great matters of industrial waste do not take place in your building trades."

Type of Outfit Sold to Greenwood County, S. C., by Tractor and Machinery Co., Atlanta, Ga., Comprising a Monarch 6-Ton Model-H Tractor and a Stockland Grader No. 7 with 10-Foot Blade

The Control of Concrete on Highways

THE Committee on Character and Use of Road Materials of the Highway Research Board, H. S. Mattimore, Engineer of Tests and Materials Investigation, Pennsylvania State Department of Highways, Chairman, presented its report to the Board on December 1, 1927, in Washington, D. C. The Committee considers the subject of the control of concrete on highways to be the most important on which the available data and general good practice should be correlated. The report this year took up some of the important features of concrete control, divided into (1) portland cement, quality and quantity control, (2) fine aggregates, (3) coarse aggregates, (4) concrete proportioning or design of concrete mixtures, (5) present practice in curing of concrete pavements, and (6) tests on finished concrete.

Caterpillar Thirty with LaPlant Choate Bulldozer Spreading Earth Fill on the Bronx Parkway Extension Near Bear Mountain Bridge, N. Y. Outfit Owned by Shacket & Scofield, Beacon, N. Y.

PORTLAND CEMENT—REPORT BY H. S. MATTIMORE

The report discusses some variations in state highway specifications for portland cement showing some differences from the general standard.

The proper sampling of cement is discussed in detail. It is recommended, where the amount of cement warrants it, that all sampling of cement should be done at the mill. This not only assures a more thorough control, but eliminates delays and allows the contractor to limit his storage to small amounts.

The proper storage of cement on the contract is given consideration and it is also recommended that cement held in local storage over winter or for periods of three months at any time should be retested before its use should be permitted for any concrete work.

Methods for controlling the quantity of cement in concrete are stated and it is recommended that the first check on cement quantities should be at the mill by the inspector taking occasional checks on the net weight of bags of cement as loaded on cars. Additional checks should be made by inspectors on the control to assure the proper amount of cement being used. Daily inventory is recommended on the amount of cement in storage and the number of empty bags on hand as well as those returned to the cement company.

One operation which is likely to be carelessly controlled is the thorough emptying of cement sacks. The amount of cement left in sacks on well-controlled projects has been found to be as much as one pound. On the use of reclaimed cement from cleaning bags, the Committee concludes, "This practice has not become common enough so as to have any standard procedure established relative to its control, but it can be readily seen that the practice might increase to such an extent that it would become an incentive to encourage careless emptying of sacks.

FINE AGGREGATES—REPORT BY M. O. WITHEY

This report discusses the desirable characteristics of properties of fine aggregates and states, for pavement construction, the qualities which are of prime importance are uniformity and a reasonable degree of hardness, toughness and durability. The Committee believes from evidence furnished by the poor surfaces of pavements made with dirty aggregate that an excessive amount of fine dust or silt is a decided detriment to the concrete-making qualities of an aggregate. It states that natural sand found in glacial deposits or in river beds forms the most valuable of present-day supplies of fine aggregate.

On the use of screenings made from dolomite, granite, trap, quartzite or other hard, durable rock, the Committee states that often these aggregates, unless specially prepared, are too coarsely graded and contain too much fine dust for most effective use as concrete aggregates. Also, such aggregates are likely to produce concretes which are more difficult to finish than those made with natural sands.

It is considered that the procedure of sampling is an important one. Methods of sampling at the producing plant and from cars are given in some detail. It is stated that it is extremely difficult to secure representative samples from stock piles. To obtain the representatives of material so stored, samples should be collected as the material is loaded into the truck or car from the stock pile.

Methods for the field testing of fine aggregates are either given or references stated. The most significant tests are, (1) visual inspection, (2) sieve analysis, (3) colorimetric tests, and (4) silt test.

The Committee is of the opinion that mortar tests of fine aggregates when properly conducted are the most informative of the simple laboratory tests ordinarily made. In discussing tensile and compression tests, the following is stated: "For determining such qualifications the type of mortar strength tests used should be governed by the kind of stress the material has received in service." It is recommended that additional research be undertaken to establish what correlation exists between the strength of mortars and the concrete containing the mortars, first, when both have the same water-cement ratio and, second, when both have the same workability, but differ in water-cement ratio. Data from such tests would indicate better methods of proportioning the mixing water in order to secure the best correlation between mortar and concrete strength tests.

By measuring inundated sands, the volume of sand and the volume of water in the batches will be practically constant. Also, factors such as changes in grading or variations in shapes of particles which influence the voids in the aggregate, will cause variation in the quantity of fine aggregate and water in the measuring cylinder.

COARSE AGGREGATES—BY H. H. SCOFIELD

The quality of coarse aggregates is an important item for consideration and regulation in the production of concrete highways. It is recommended that detailed examination be made at the source of the aggregate for evidence of unsoundness in exposed ledges. Also, variation of quality in different layers or beds should be observed. The sampling of coarse aggregates is discussed and the importance of securing representative samples is emphasized. Detailed methods for sampling from cars are given. It is also recommended that coarse aggregates be not sampled in stock piles except possibly when being used. Relative to storage, it is recommended that stock piles be built in flat layers of from 2 to 4 feet in thickness so that segregation of sizes is kept to a minimum.

The Committee believes that accuracy and consequent value of standard abrasion tests of the American Society for Testing Materials would be much greater if the test cylinders of the abrasion machine are slotted to remove the dust. It is stated that the Rea abrasion test for the control of gravel has been used successfully.

The soundness and durability of aggregates are discussed and the purpose and limitations of the sodium sulphate test given.

It is stated that alternate freezing tests are valuable. Along this line it is considered there is need for more investigational work for the correlation of test results with behavior under exposed conditions in concrete. Finally, the Committee is of the opinion that a high degree of uniformity in concrete is essential in good practice, and that a coarse aggregate of constant grading is very important in its effect on uniformity. Field control of sizes is recommended and field inspection methods provided to insure that the specified coarse aggregate is furnished. Piling in stock piles, cars or bins should be so controlled as to minimize segregation and accurate quantities measured either by weight or struck volumes.

PROPORTIONING DESIGN OF CONCRETE MIXTURES—REPORT BY R. W. CRUM

The report discussed the theory of the design of concrete mixtures and quotes the data from the report of design of concrete mixtures by Committee C-9, the American Society for Testing Materials, 1927 report.

Under practical application a recent bulletin by A. T. Goldbeck, National Crushed Stone Association, on the water-cement specifications for concrete and its limitations, is referred to. In this bulletin Mr. Goldbeck concludes by proposing a specification based on the use of the water-cement ratio. This differs from the usual water-cement ratio specification in that preliminary strength tests are required to establish the particular water-cement curve applicable to the material to be used on the job and, second, the proper adjustments are made for different temperatures to be expected during the progress of the work.

Several precautionary measures are given in the use of designed theories as follows: No matter upon what method or theory the design of mixture is based, the authorities agree that upon actual construction it is necessary that a constant ratio of water to cement be maintained. This entails the accurate measurement of all material. The basis for uniform concrete is uniform measurement of all materials so that all batches will have identical composition. This involves in addition to accurate measuring devices, means for rapid, frequent determination of moisture content or absorption and adjustment of batches therefor. Also, the following quotation is given pertaining to actual practice. "In the letting of contracts for public work involving large quantities of concrete as in concrete pavements, it is desirable to specify mixtures for the various materials that may be used, definite enough so that the contractor may have reasonable certainty of the actual amounts of materials actually needed for the work. If definite proportions of water, cement and aggregates are specified the quantities of cement and aggregates can be very accurately estimated. This is of importance because any provision of the specifications that reduces uncertainties is bound to have a good effect upon cost." One very valuable feature of the report is a definite example of the utilization of aggregate mixtures low in coarse aggregates. The grading of the material is given, and the detail method for design is followed through, showing how concrete of a desirable strength can be obtained.

CURING CONCRETE PAVEMENT—REPORTED BY F. H. JACKSON

This report discusses the several methods of curing which are being used to some extent as alternates for the standard water curing. The report states, from the strictly economic point of view, almost all of the proposed methods of curing are preferable to the old-style water-curing process, largely because of ease of application and the fact that no attention is required subsequent to application. Probably no feature of the construction project is so difficult to control as curing by means of water, due to the difficulty of obtaining an adequate supply over several days' run of pavement, also adequate supervision of the sprinkling operation is extremely difficult.

Sodium silicate, calcium chloride, asphaltic emulsions and bituminous paint covers are given as methods of surface coating which have been tried to some extent in practice. It is stated that research and experimental activities in connection with the use of these special curing agents have so far been confined largely to studies of the value of calcium chloride. It is also stated that experience with calcium chloride as a surface curing agent in some states has indicated that its use for this purpose may be associated with surface scaling. This probably is due to the non-uniform application of the salt to the surface of the pavement. But it is also stated that it is in fact quite difficult in actual construction to secure an even distribution of the chemical even by means of the special devices which have been placed in use.

The report indicates that the amount of humidity is a great factor in the efficiency of surface curing with calcium chloride. In regions of low relative humidity and high temperatures, reports indicate that calcium chloride may not successfully be used in this manner.

In regard to the use of calcium chloride as a curing agent in the form of an admixture, the report states that its use seems to have been justified as a result of experience in actual construction. The efficiency of the material used in this way depends upon atmospheric conditions. For instance, certain of the southern states which have attempted to use calcium chloride integrally have experienced difficulty due to rapid hardening during hot weather. On the other hand, many of the northern states, such as Pennsylvania and Connecticut, have successfully used the integral method. Data, which has been so far secured, indicates that under the average temperature and humidity conditions prevailing in the northern states, concrete of satisfactory quality is obtained by the use of this curing method.

The use of surface treatments for the purpose of sealing moisture within the concrete has been tried out to a certain extent in the field. Reports on the efficiency of these methods should soon be available. It is recommended that carefully controlled experiments made under varying conditions of temperature and humidity are needed in order to determine under what conditions such surface seal coats are effective. The necessity for early curing is emphasized and the need for more research on curing methods alternate for the standard water curing is urged.

TESTS ON FINISHED CONCRETE—REPORT BY F. C. LANG

This report states that where large quantities of concrete are required, it may be economical to apply the latest developed principles using laboratory methods and employing very rigid control of every operation. For such concrete a small factor of safety could be used in design. On the other hand, for small yardages, it may be more economical to spend less for field control and more for materials.

The objects of making tests in finished concrete are, first, to ascertain the strength of the concrete at any particular time. This is of value in knowing when to open pavements to traffic or to remove supports in bridge construction. Second, to determine the ultimate qualities and uniformity of the concrete. This is of value in ascertaining whether the manufacturing process has been properly carried out and should be final proof of the intelligent control of materials and manufacture.

The report states that at the present time the three following methods of determining the quality of finished concrete are generally used: (1) the compression test made in the laboratory on specimens moulded and partially cured in the field; (2) the compression tests made in the laboratory on specimens drilled from finished concrete at various ages; (3) the transverse tests made in the field on specimens moulded and cured in the field. It is emphasized at this point that great care must be taken in the moulding and curing of field specimens and it is stated that the results of tests are only indications of the quality of the concrete when the variables of making, curing and testing are reduced to a minimum. It is preferable to make tests that will determine directly the property or properties desired. From this standpoint compressive tests on the moulded specimens are desirable for concrete structures which are

designed for compression. The compression tests made in the laboratory from specimens drilled from finished concrete are of considerable value in testing the concrete in pavements. It has been extensively used for this purpose and seems to have good moral effect in that it not only gives indications of the strength quality, but also shows the thickness of slab.

When a Gasoline Engine Won't Start

TEST the spark. It should be blue, white or yellow, not greenish red.

Even though there is a spark of the right color, it may not be strong enough. Put three or four thicknesses of dry newspaper between the points of the spark plug while it is lying on the engine. A good spark will jump through, leaving a tiny hole. If it will not do this the spark is too weak.

WIRING

Look over all wire connections to see that they are tight and clean and there are no short circuits.

THE MAGNETO

See whether oil has accumulated on the contact points in the breaker box. If oily, rinse with a little gasoline and wipe dry. If rough or pitted the points should be filed.

See that the commutator brush is clean.

Engines used out of doors, such as gas tractors, should have a waterproof cover to protect the magneto from moisture and dust.

THE CARBURETOR

Be sure the carburetor is full, and full of gasoline—not water that has condensed on the sides of the gasoline tank and gradually settled down to the carburetor. The settling chamber should be drained and cleaned frequently, especially in cold weather. Water collects there and is likely to freeze.

See that the needle valve is open.

Pour a teaspoonful of gas into the combusion chamber. Allow it to stand for a minute or two to vaporize and mix with the air. Then crank the engine. If only one or two explosions occur the priming alone has burned and the carburetor is not getting enough fuel.

STARTING IN COLD WEATHER

If the engine won't yield to ordinary persuasion, try one of these:

Put a teaspoonful of gasoline into the cylinder. This will work in moderately cold weather.

Fill the radiator with hot water, or pour it over the intake manifold, or over the carburetor.

Wrap a cloth around the intake manifold and pour the hot water over the cloth; or dip the cloth in hot water and then wrap it around the manifold. Crank the engine rapidly.

If hot water cannot be obtained, apply a blowtorch to the intake manifold; or by removing a spark plug, heat the combustion chamber itself.

One of the most effective methods of starting a cold engine and one that is absolutely safe is to remove the spark plug and heat it in a flame, prime the engine, and then quickly replace the spark plug. A drop or two of gasoline put on the inside of the plug just before replacing it insures the presence of evaporated fuel near the spark plug when the engine is cranked.

WELL, TRY THIS

Heat a piece of metal pipe the size of the air intake of the carbuetor, then place this so all air entering the carburetor must pass through it.

High-test gasoline or ether may be used to prime the engine in very cold weather. The latter is somewhat dangerous, as it burns easily, and it should always be mixed with gasoline. There is no danger in the use of the high-test gasoline.

THE LAST RESORT

If the engine still won't go, telephone immediately to the nearest expert on gasoline engines. You will probably find when he arrives, with a full assortment of tools, prepared to take the whole thing to pieces that it will start without any trouble.

From *Job Jottings*, published by Hubbard-Floyd Co., Equipment Distributors, New York City.

If you would be well spoken of, learn to speak well of others. And when you have learned to speak well of them, endeavor likewise to do well to them; and reap the fruit of being well spoken of by them.—EPICTETUS.

Remarkable Timber Record

TIMBERS used for more than thirty-four years as piling and structural supports for a wood bridge over Hurricane Creek on the Tuscaloosa-Birmingham Highway were found to be absolutely sound and suitable for further use when removed recently, according to a report of W. H. Nichols of Elrod, Ala., to the Southern Pine Association, reading as follows:

"Though thirty-four years old, some of the native pine timbers driven into the ground in the construction of the Hurricane Creek bridge on the Birmingham Road were found the other day, when the bridge was taken down, to be as sound as when they were first used. The timbers were first driven into the ground and then heavy piping was slipped over them to support the weight of the bridge. Waste space inside the pipes was filled in with rocks and gravel.

"The other day when the old bridge was being taken down it was found that the timbers were still so sound that they could not be pulled from the ground and they were broken off in an effort to get them out of the way. Data on the old bridge gave workmen the age of the timbers and the timbers, approximately 18 inches in diameter, were found to be as sound as the day they were put into the construction of the bridge."

A Koehring Crane Sold by Coulter-Hart Equipment Co., Tampa, Fla., Lifting a 14-Ton Cannon Being Mounted in a Public Park

Conveyors Handle Concrete on Viaduct Job

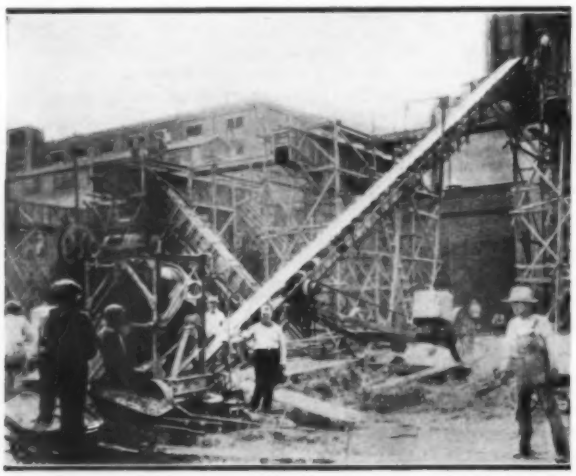
By Jack Turner

THE completion of the new Seventh Street Viaduct, now under construction in Decatur, Illinois, will mark another triumph for the belt conveyor in handling not only sand and gravel but wet concrete. This viaduct which will reach from one side of town to the other is 2,700 feet long exclusive of approaches, 30 feet high and 40 feet wide. During the latter part of this month it will be opened for automobile and pedestrian traffic, and will present an ultra-modern aspect from all distant views of Decatur with its slender concrete columns bearing up its stream of cars and people.

The job is in the hands of the Jones Engineering Co. of Omaha, Nebraska, which has used belt conveyors for some time and naturally used them in all places on this job where an economical application could be found.

A Barber-Greene 24-inch x 50-inch belt conveyor carries the aggregate from the stock piles to the Smith mixer and a Barber-Greene 18-inch x 60-inch conveyor for handling practically all of the wet concrete poured. The conveyor that is being used for the wet concrete was previously used by the Jones Engineering Co., on their Grace Street Sewer job in Omaha, Neb., during which the machine handled 40,000 cubic yards of sand and gravel. The conveyor was put on the present viaduct job in Decatur with less than $25.00 in repairs.

The conveyor has poured an average of about 90 yards per nine-hour-day, handling thus far a total of 3,635 cubic yards



Delivering Concrete by Conveyor. This Photograph Was Taken at a Time When the Aggregate Conveyor Had Not Been Moved Up, So the Smith Mixer Was Temporarily Supplied by Wheelbarrow

of concrete. It is necessary to move the entire "set up" about once a day. The time required for this operation is, of course, governed by how far the machine must be moved. The average move is ninety feet, however, and takes ten men thirty minutes. This includes moving the entire set-up—conveyor, mixer and hopper.

ADVANTAGES OF BELT CONVEYORS

If the belt were not employed it would be necessary to install either a movable hoist or tower, and although a mix which tests a 5-inch slump is generally used on this job—the slightly drier mixes that are occasionally used would not "chute" satisfactorily without flushing. Segregation is also a point to be considered, especially where such a wet mix is used. With the belt, although segregation is not entirely eliminated, it is cut down to a negligible figure. It is clearly seen that in pouring wet concrete the belt conveyor is ideal at either extreme of moisture content. If the mix is such that the slump is very low, say from 1 to 2 inches—it is too dry to chute, unless it is shot down such a steep angle that the resulting segregation makes the method prohibitive. If the mix is very wet, say with a 5-inch slump, although it will chute at a practical angle, the material, due to its extreme dampness, is very susceptible to segregation, and must be handled much more gently than the chuting system can convey it. When such care is exercised to have the material properly mixed, it can hardly seem logical to deliver the concrete to its destination by a means that destroys the results so carefully obtained in the mixer.

THE VIADUCT

The thin mix was used on this viaduct job on account of the length and slenderness of the columns. The conveyor carried the mixed material from the mixer to the top of the forms where it discharged into a metal box. From there it was wheeled to the columns and poured.

In the new viaduct there are 61 sets of columns and girder beams, and 8 collision struts, columns and beams across the railroad tracks. The 61 sets of columns are 2 feet square and from 10 to 28 feet in height. On the top of the column is a girder beam 2 feet wide by 2 feet 4 inches high. The collision struts have columns measuring 2 x 4 feet and beams that vary from 3 to 7 feet in height. The buttress walls are 120 feet long and from 10 to 16 feet high, 6 feet wide at the base and 2 feet wide at the top. All walls, columns and beams were poured with material handled on the conveyor. The bents average 30 feet 6 inches on centers and from 2 to 4 bents were set up with one set. The mixer is mounted on a movable platform with a 76-foot tower for pouring the joists and floor slabs.

Steel vs. Concrete

Editor, CONTRACTORS AND ENGINEERS MONTHLY:

In an article entitled "Materials for Bridge Construction" in *Contractors and Engineers Monthly* of December, the claim for steel is presented as against concrete in an unreasonable manner as the writer views it.

The statement that a steel structure as soon as complete can be relied upon absolutely to carry the loads for which it was designed while a concrete structure must not be loaded to full capacity until it has thoroughly set, which usually takes several weeks, is somewhat misleading and not at all in accord with general experience.

For instance, as far back as 1907 the writer designed a stock house for a brewery building. Each panel carried four 50-ton tanks. The work was put in at temperatures ranging as low as 20 degrees below zero part of the time and the concrete structure was complete before the structural steel could be fabricated and delivered on the ground. Incidentally, that is the reason why it was built of reinforced concrete. The materials were placed hot and the lower slabs which were wanted at once were steam cured and ready ten days after casting.

In building a reinforced concrete building in Fort William, Ontario, at a temperature of 20 degrees below, in applying the cork insulation with pitch the workmen carelessly allowed the pitch to catch fire from a salamander and the centering burned out under one floor and the roof. The roof concrete was not seven days old and yet it stood up with some pitting and some cracking of the fireproofing about the columns. The expense of making it good after this fire was small, whereas had the frame been of steel it would have been an entire wreck.

About eighteen years ago the writer was awarded second prize in the Grand Avenue Viaduct competition in Milwaukee, on the ground that his design was "a handsome structure but a bold design considerably in advance of the present American practice." The Engineers Committee were Messrs. Steinhagen, Modjeska and Turneaure.

The only thing about the design which then was bold was a 7-foot over-hang for a sidewalk and the only unusual feature was a hooped concrete rib such as subsequently used by me in

the Mendota-Snelling Bridge in thirteen 304-foot arch spans.

At Fort Snelling with three sets of forms, one 304-foot arch with the floor 62 feet wide was completed in from twenty to twenty-two days above the skew backs after the work was well under way. This speed compares favorably with the best time made in steel erection. Further than that, the arches were subjected to the load of their own weight and 200-ton concentrated load at the center of the arch on striking the centers with a deflection of from 5/16 to 3/8 inch, dependent on whether the piers penetrated solid material or were emplaced in a skew with semi-liquid mud for fifty feet below the surface.

The statements about work in freezing weather are misleading. We prefer, in the North, to build bridge piers in winter. In the Bismarck-Mandan Bridge one of the caissons was built on top of the ice, the ice sawed through and the pier base shell dropped through the ice and sunk by digging as it was built up.

One of the advantages of the reinforced concrete structure is that its dead weight is greater proportionately than that of the steel bridge. Consequently a well designed concrete bridge cannot be as readily overloaded as the steel bridge having a less favorable ratio of dead to live load.

The reinforced concrete bridge is cheaper for heavy loads and moderate spans than the steel structure. For light loads and long spans the steel bridge is in general cheaper than the concrete bridge. A first class, wide, city bridge may in general be built of reinforced concrete cheaper than of steel.

From the standpoint of permanence, concrete is permanent or lacking in permanence, dependent on what it is made of and how it is made, mixed and placed. In like manner the strength of steel depends on how it is made and how it is handled in the shop. The writer has seen a car load of steel coupler pockets that fell apart in riveting them in the cars in the Soo Line Shops in Minneapolis. They were fabricated in Pittsburgh. In inspecting them the writer found that many of them were in such shape that he could fracture 11 square inches of metal with a single blow of the sledge. Taking the shank to a steam hammer he found that it could be bent nearly 180 degrees on itself and that the trouble was that of burning the steel in the forge.

This illustrates the fact that good workmanship is just as necessary in steel construction as in concrete construction. The element of inspection cannot be eliminated with either one.

We come now to the question of theory. That steel can be figured and concrete cannot, is the theme of the steel idealist. We had some examples of correct computation of steel. The double collapses of the Quebec bridge are in point. In building codes and specifications based upon the ordinary theory of flexure there is an inconsistency in determining shear strain of the ordinary beam dependent on the degree of restraint of two or three hundred per cent, as may readily be demonstrated. When it comes to computing the elastic deflection of the wide flanged beam by the ordinary theory an error of ten or fifteen per cent is discovered and yet the deportment of a 2-way concrete slab under a load of one or two hundred tons can be determined with practical precision.

As we have designed and built many steel bridges, some concrete bridges and concrete buildings running into the thousands, it may not be presumptuous to presume that he have a working familiarity with both classes of construction and are able to judge their merits without prejudice.

Each has its own particular field dependent on the site, character of foundation, weight to be carried and the economic costs of materials entering into the structure. Steel deteriorates by rust. Concrete is more permanent if properly made and does not require continual painting. On the other hand if kept well painted and given the care which is not ordinarily bestowed upon it the steel structure will outlast the present generation and the concrete structure should outlast many to come.

Concrete work executed in winter and properly cared for is stronger and better than that executed in summer for the reason that in heating the water, surface tension is eliminated and a better mixture secured. The reverse is true if the concrete is not properly cared for after being placed. Prejudice or lack of familiarity with construction methods should not militate against the most advantageous use of both classes of material. Neither will replace the other entirely because each possesses advantages under certain circumstances which the other lacks.

In the ordinary text book dealing with strength of materials, assumption in place of elastic theory is erroneously presented. The modulus of rigidity or shear is treated as though an infinite instead of finite quantity approximately three-eights the value of the modulus for tension or compression. Until our theoretical friends develop a rational basis of computation, based on the natural values of the elastic coefficients in lieu of a value for shear, infinitely different therefrom, there will be little preference between the inaccuracies and inconsistencies of the theory of steel design and that of reinforced concrete.

Many steel bridges are inherently ugly, a fault not of the material but rather of the failure of steel designers to develop economic theory and realize the general law that lines of economic strength are inherently graceful. An ugly structure is invariably lacking in economy.

The concrete bridge is fireproof. The steel bridge is not. In Vancouver, B. C., one of the main viaducts was wrecked for a distance of 900 feet through burning of the floor system. This and another bridge fire was attributed to German spies, but the writer is inclined to think the true origin was a North American cigar or cigarette stub. The Georgia Harris Viaduct of that place, as a result of a competition with twenty engineering firms, was built largely of reinforced concrete. Some structural steel spans over the railroad yards at the west end were encased in concrete to render them safe should there be a fire in the yards. The floor of concrete and the top chords of steel were made unitary, giving the spans an exceptional degree of stiffness.

The effect of locomotive gases on overhead crossings is negligible in a first class concrete structure, whereas with steel corrosion is rapid and frequent painting does not suffice to properly protect the steel. In Minneapolis a number of years ago, the steel girders crossing over the tracks in front of the Union Station gave way under a street car. The motorman, feeling the floor give, put on power and brought his car over the opening just before the girders collapsed, leaving the rails suspended. The falling girders, brick and débris just cleared the end of a local passenger train coming in from the lake. Failure a half second sooner would have resulted in a large loss of life.

The fireproof character of concrete and its resistance to locomotive gases is a strong reason for the use of concrete in many of our city bridges.

DR. C. A. P. TURNER, C. E.
300 Builders Exchange, Minneapolis, Minn.

Largest Construction and Engineering Firm Organized

ANNOUNCEMENT has been made of the organization in Philadelphia, Pa., of what is believed to be the largest engineering and construction company in the country, with contracts in hand amounting to more than $100,000,000. The name of the new company is the United Engineers and Constructors, Inc., and it is comprised of four companies widely known in this and other countries. Headquarters will be in Philadelphia, with offices in New York, Newark, Chicago, Los Angeles, Atlanta, Houston, Pittsburgh, Montreal, Buenos Ayres and Rio de Janeiro.

Dwight P. Robinson is President of the new company. The directors are Mr. Robinson, Thomas N. McCarter, President of the Public Service Corporation of New Jersey; Samuel T. Bodine, Chairman of the United Gas Improvement Co.; Paul Thompson, Vice-president of the United Gas Improvement Co., and John E. Zimmermann, President of Day & Zimmermann, Inc.

Essence of A. G. C. Committee Studies

THE Ninth Annual Meeting of the Associated General Contractors of America, Inc., held at the West Baden Springs, Hotel, West Baden, Ind., January 23 to 27, brought to the several hundred contractors and manufacturers attending the convention, addresses and frank discussions of the mutual problems of the general contractor, sub-contractor and manufacturer.

George B. Walbridge, Chairman of the A.G.C. Committee on Legislation, reported on the reintroduction before Congress of the Day Labor Bill, and other measures which have been drawing attention recently. The outstanding interest of the Association in legislative matters during the past two years has been centered on this Federal bill to require government agencies to call for competitive bids on construction work and to perform the work by contract where those bids are reasonable. This measure is aimed particularly at those government agencies which have sought to carry out their own ambitions by driving private industry out of Federal construction under the pretext of saving money. The purposes of the bill are in no way contrary to public interest and when enacted should help to establish a public policy that has long been recognized as sound and economical.

W. F. Austin, Chairman of the Committee on Accident Prevention reported on the amazing growth in 1927 of the accident prevention campaign. Since the Association's Convention at Asheville, N. C., a year ago, where the safety campaign was planned, the movement has grown with surprising rapidity and most satisfactory results. Several chapters and branches now are actively interested in accident prevention work and the safety engineer who was added to the headquarters staff of the organization at the beginning of the campaign, finds numerous demands upon his time for speaking engagements and visits to chapters to explain the work. An effective display of safety slogans appeared near the Registration Desk.

Lion Gardiner, Chairman of the Mixer Manufacturers' Bureau, reported progress and stated that many states are adopting the concrete mixer standards through the efforts of the A.G.C. members and secretaries. The membership of the Bureau now includes: American Cement Machine Co., Keokuk, Iowa; Archer Iron Works, Chicago, Ill.; Chain Belt Co., Milwaukee, Wis.; Construction Machinery Co., Waterloo, Iowa; Foote Co., Inc., Nunda, N. Y.; Jaeger Machine Co., Columbus, Ohio; J. B. Foote Foundry Co., Fredericktown, Ohio; Knickerbocker Co., Jackson, Mich.; Koehring Co., Milwaukee, Wis.; Lakewood Engineering Co., Cleveland, Ohio; Marsh-Capron Co., Chicago, Ill.; Orr & Sembower, Inc., Reading, Pa.; Ransome Concrete Machinery Co., Dunellen, N. J.; Remmel Manufacturing Co., Kewaskum, Wis.; T. L. Smith Co., Milwaukee, Wis.; and Standard Scale and Supply Corporation, Pittsburgh, Pa.

A Koehring 301 Crane Sold by the Geo. W. Smith Co., Dallas, Texas, to the Julian C. Field Co., Denison, Texas. The Same Distributor Sold a Very Complete Paving Outfit Including a 27-E Koehring Paver, Bins, Batchers, Road Rails, Subgrade Planer, Finishing Machine, etc., with This Crane. This Equipment Was Shipped Direct to Sweetwater, Texas, for the Nolan County Job, Which Called for 15 Miles of 18-Foot Bates Type Concrete Road

Alex Simpson, Jr., Chairman of the Committee on Quantity Survey, reported on the benefits of the system, and urged building chapters not having this service for their members, to give close study to its benefits, and seek the advice of the staff and other chapters familiar with the subject.

Arthur S. Bent, Chairman of the Committee on Ethics, reported on the five cases of alleged breach of business conduct which the Association handled during 1927, and said that there are competitive conditions in the industry which cannot be cured by a code of ethics, but will require education and a furtherance of the spirit of cooperation. The Committee urges that the question of group cooperation and ethical practice be given earnest attention.

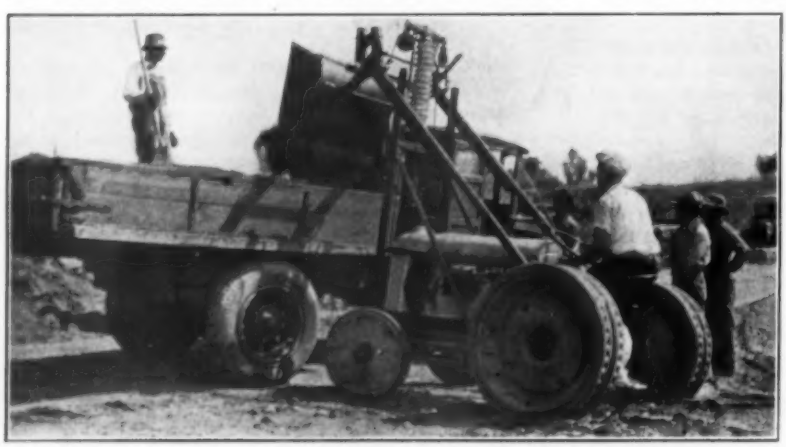
T. J. Pardy, Chairman of the Committee on Material and Equipment, reported on sales practices and wholesale discounts. The Committee desired particularly to emphasize the need for a tightening of credit investigations and sales practices.

F. L. Cranford, Chairman of the Committee on Insurance and Bonds, reported on the opportunities in 1928 for bringing about bonding reforms.

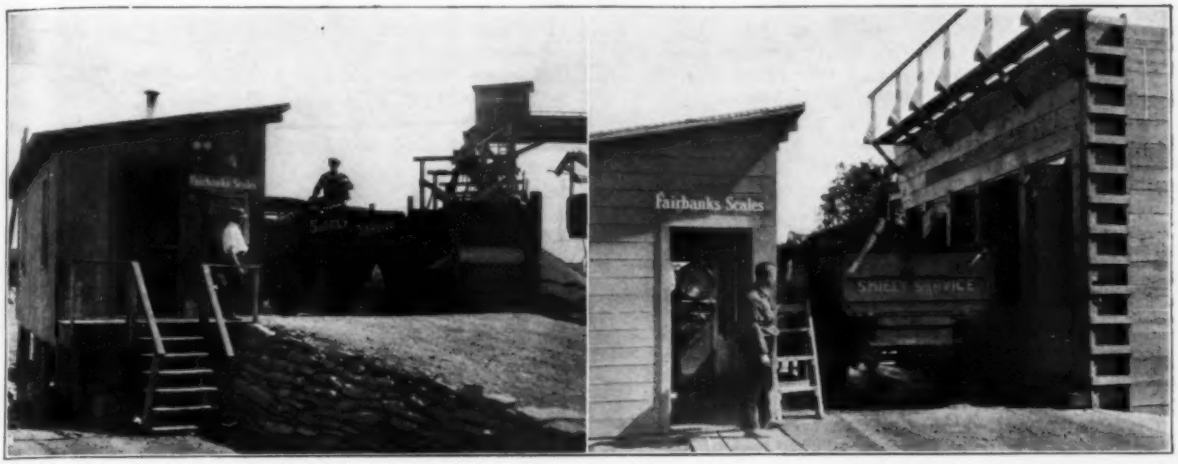
Natt McDougall, Chairman of the Committee on Labor, reviewed the prime features of the labor situation during 1927. He spoke of the decreased pressure from labor for an increase in wages proportionate to the demands of the past few years, of labor's added emphasis upon the five-day week and the abandonment of the National Board of Jurisdictional Awards by the Building Trades Department of the American Federation of Labor.

D. B. Fegles, Chairman of the Committee on Methods, stated that the Association has been able to interest the Bureau of Internal Revenue in a cooperative study of depreciation. Investigation of this subject with respect to income tax returns has been in progress approximately a year under the direction of a Special Committee of the Association. The Committee urged that estimating and cost accounting be made a major subject in the functioning of the A.G.C. local organizations during the coming year.

John W. Cowper, Chairman of the Committee on Contracts, reported on the definite accomplishments that marked the standard contracts movement.



A North Hydraulic Digger Loading Gravel



The Sheily Co. Installed Two 20-Ton Auto Truck Scales with Dials, the One in the View at the Left at its Crushed Rock Plant and the Other at Its Sand and Gravel Pit

Selling Aggregates by Weight

MIXING concrete, stucco and plaster on weight specifications rather than by volume seems to be becoming more popular with large organizations dealing with materials of this type. The J. L. Shiely Co., sand and gravel dealer of St. Paul, Minn., has been weighing its outgoing sand, gravel and crushed rock for over two years. This came as a result of tests made by the Department of Public Works of St. Paul, which found that one yard of Shiely sand with moisture removed weighed 2,900 pounds. Further investigation showed that the sand taken from the bank had from 2 to 8 per cent moisture while sand taken from the Shiely stock pile contained a maximum of 5 per cent moisture. Sand coming directly from the plant contained 17 per cent moisture.

Two 20-ton, 20 x 9-foot type "S" auto truck Fairbanks-Morse scales with full capacity dials and equipped with auto truck tare bars, were installed. Reinforced concrete platforms were put on to make the installations complete. One scale was installed at the crushed rock plant and the other in the sand and gravel pit.

In deciding the allowance for moisture and how this method of marketing would be sold to the trade, the stock pile sand and the plant sand percentages were taken as the basis. A scale ticket was prepared which showed the gross, tare and net tons and the percentage which was to be deducted for moisture, a Moon-Hopkins billing machine typing the date, name, address and other details such as the total weight with deduction for moisture percentage, yards, price per yard and the total extension.

In convincing the buyers of sand that it was advantageous to them to buy by weight, a promotional circular showed that 4 yards of washed sand by weight equalled 5 yards of so-called dry sand by volume. Reference was made to the fact that the Lewis Institute of Chicago showed by tests that dry sand when moistened 4 to 6 per cent will swell fully 25 per

SHIELY SERVICE
SCALE COPY

J. L. SHIELY CO., Inc.
WASHED SAND, WASHED GRAVEL, CRUSHED ROCK
Office
210 Builders Exchange
6th and Jackson St.
Telephone Cedar 3730
Plant Telephones
Sand Pit Midway 5128
Rock Plant Dale 3580

TIME

Truck No. Zone St. Paul, Minn., 192
Delivered to
At
Billing Address

Yards	KIND		WEIGHT		Driver
	TWO INCH	GRAVEL	7600	Lbs. Gross	ON
	ONE INCH		2880	Lbs. Tare	
	ROOFING		4720	Lbs. Net	X OFF
	CONCRETE	SAND	Deduct 5	% Moisture	
X	PLASTER		4484	Net Weight Dry Material	

YARDAGE

Licensed Weighmaster

No. E 02674 Received by
Sign full name, please.

J. L. SHIELY COMPANY, Inc.
210 BUILDERS EXCHANGE ST. PAUL, MINN

Crushed Rock Washed Sand Washed Gravel
Agricultural Lime

Order No. and Date 684-
Requisition No.
Contract No.
Shipped to
Destination
Invoice Date JUNE 13, 1927

This column reserved for customer
P. A. Invoice No.
Voucher No.

TERMS: Net Cash 30 Days

ROBERT SMITH
1595 STANFORD
CITY

With order
F. O. B. Point
Price
Calculations
Transportation
Trans. Chgs. Back

DATE	TICKET NO.	WEIGHT	YARDS	KIND	DELIVERED TO	PRICE	EXTENS	TOTAL
6-13	2505	4370						
	48	4370						
	54	4636						
	60	4446						
	609	4351						
	15	4160						
	67	4446						
	70	4332						
	70	4332						
	71	4446						
	74	4484						
	79	4484						
		52877	16.23	F SAND	PIT	.90	16.41	16.41

Above materials received ..... 192 ..., and same is ..... satisfactory. (Signed) ..... (Title) .....
Charge account ..... Approved ..... Approved .....

The Weigh Ticket Shows the Gross, Tare and Net Weights in Pounds with Deduction for Moisture, Leaving a Net Weight of Dry Material. The Invoice Is Made Out on a Moon-Hopkins Billing Machine, Showing the Date, Weigh Ticket Number, Net Weight of Dry Material, Yards Based on Weight of Dry Material, the Price and the Extension

cent. And it was demonstrated that 4 yards of Shiely sand by weight at $1.50 per yard was cheaper than 5 yards of so-called dry sand by volume at $1.25 per yard.

Crushed limestone, according to size, varied from 2350 to 2500 pounds per yard by volume and in this case the Shiely Co. gives 2500 pounds per yard by weight. In other words, a customer buying 6 yards of pea rock by weight from Shiely would get 900 pounds or over 1/3 of a yard more than if he purchased the same amount of pea rock by volume.

Washed gravel varied in weight from 2610 to 2800 pounds per yard by volume and concrete gravel weighed 2935 pounds per yard by volume. The Shiely Co. gives 2800 pounds of gravel per yard by weight for roofing and reinforcing gravel and 2950 pounds by weight for concrete gravel. Five yards of 2-inch gravel weighs 13,050 pounds by volume. Shiely gives 14,000 pounds of 2-inch gravel by weight or better than 1/3 of a yard more than by volume.

The Shiely promotional piece showed that careful tests by competent engineers prove that for every pound of dirt in gravel or rock a corresponding amount of cement is wasted. Thus concrete made with 600 pounds of cement to the yard of gravel or rock containing 10 per cent dirt, is no stronger than concrete made with a clean washed gravel or crushed rock but containing only 300 pounds of cement, thereby showing not only the value of weighing the materials used but also stressing the importance of having materials of good quality.

On a busy day at the sand plant there are many loads of sand and gravel to be weighed, but with the dial scales all weighing is handled with speed and accuracy and everything is kept in motion without any congestion. All guess work has been done away and the result has been the procuring of some large contracts.

A Method for Discarding Surplus Sand

A PROFITABLE and efficient method for discarding surplus sand has been used by the Birnie Sand and Gravel Co. of North Wilbraham, Mass. The sand separator used in this method was designed and constructed by the company itself and cost approximately $6,500 complete. The saving effected in the operation of rehandling waste sand more than paid for the cost during the first season's use, according to a report of A. C. Birnie, President of the company, in a recent issue of the Bulletin of the National Sand and Gravel Association.

"The sand separator consists essentially of a gravity screen mounted on a flat car. The material is loaded from the bank to a hopper attached to a flat car and is elevated by a 48-inch Pan-Conveyor, made by the Jeffrey Manufacturing Co., to the screen.

"The amount of sand which passes through the screen is regulated by means of a chute mounted over the screen. This chute, 11 feet long and 2 feet wide, is fixed at the lower end, but may be raised or lowered at the upper end, and, in this way, adjusted to receive varying proportions of the discharge from the conveyor before it falls on the screen."

The surplus sand passes through the screen into a hopper, from which it is fed to a belt conveyor, which carries it to a waste heap at the side. The material which is rejected by the screen runs through a chute to a hopper, supported on the flat car, from which it can be loaded into the open top car which transports it to the plant. The cars into which the sand is loaded and transported to the plant can be run under the hopper and the sand and gravel is discharged through six segment gates arranged so as to distribute the material evenly in the car.

"When a through cut is being made, that is, when the shovel is working directly behind the sand separator, the separator must be moved as often as the shovel. When working in a side cut, the sand separator need be moved only once for every three moves of the shovel. While in operation the separator is supported and steadied by means of five jacks, two at the rear where the shovel dumps, two at the front under the 16-cubic-yard hopper, and one directly under the sand waste conveyor."

Only one man is used in connection with the operation of the sand separator, his principal duty being to close the gates when the car is filled with the aggregate and to do the necessary oiling. Records of the company show that the use of this method of handling sand and gravel has increased the capacity more than one-third, since it permits sending to the plant only material which is desired to fill the orders.

The Gila River Bridge in Arizona

ONE of the most important links in the Arizona Highway System is the new steel bridge over the Gila River on the Phoenix-Yuma Highway near the Gillespie Dam which was opened to traffic August 1, 1927.

The new bridge, the longest steel highway bridge in Arizona, is 13 miles from Hassayampa and 24 miles from Gila Bend. It eliminates the crossing on the apron of the dam which before the construction of this new highway link was used by tourists motoring to and from California.

During the flood of last February, the crossing over the apron of the dam was rendered impassable for days by the roaring water, and tourists' cars were lined up on each bank of the river. At that time, the torrent was 6 feet over the top of the dam and within 7 feet of the bottom of the steel flooring. The bridge was then 80 per cent complete. The contractor encountered heavy losses in material and equipment through the flood and the completion of the bridge was delayed for two months.

Construction work on the Gila River Bridge near Gillespie Dam was begun in February, 1926, by the Lee Moor Contracting Co. of Tucson, Arizona. The structure is composed of nine steel spans, five 200-foot spans over the main channel with four 160-foot spans, or an overall length of 1660 feet of steel. The total length of the bridge from end to end of the paving slab is 1701 feet.

Wakefield sheet piling with steel shoes was used in sinking the shallow piers. Two types of cofferdam were used in the deep piers, steel sheet piling and open timber cribs.

The steel spans are all of the through-riveted type with a clear width between railings of 21 feet, giving ample width for two traffic lanes.

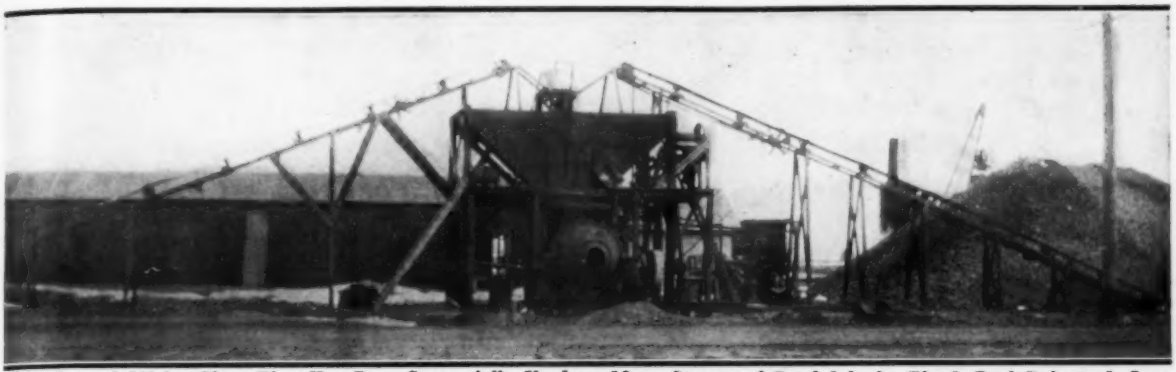
According to *Arizona Highways*, the Gila River Bridge in addition to being the longest steel highway bridge in the state has the deepest foundation, 20 to 40 feet in depth. Piers 1, 2, 3, 4 and 5 and Piers 9 and 10 are built on solid rock, while Piers 6, 7 and 8 rest on hard caliche. Pier 7, 40 feet below stream bed, is the deepest pier. The piers are of the heavy gravity type, while Pratt trusses are used with curved top cords.

In sinking Piers 6 and 7, considerable trouble was encountered through the waters. To fight this problem at Pier 7, two 12-inch Byron-Jackson vertical deep well pumps with a capacity of 3600 gallons per minute and a 16-inch horizontal belt-driven centrifugal pump of 4500 gallons per minute capacity were used continuously for five weeks.

The total amount of steel in the bridge approximates 1200 tons and the concrete poured in the foundation approximates 3200 cubic yards. About 5600 cubic yards of earth were moved in excavating for foundations.

The bridge is designed under modern specifications for live loads and heavy trucks for bridges on the Federal Aid highway system. The concrete floor and its supports were designed for two 15-ton trucks abreast on the bridge with an additional allowance of 30 per cent for impact. In this floor alone, there is a total of 930 yards of concrete and 75 tons of reinforcing steel, sufficient material to build complete a fair-size bridge.

The abutments are of the U-type with a pier for the support of the span and reinforced wings tied by reinforced concrete ties in the earth fill, making an economical type for the height, which, on the east end of the bridge, is approximately 35 feet from grade to the bottom of the foundations.



The Central Mixing Plant That Has Been Successfully Used on Many Street and Road Jobs by The J. Fred Roberts & Sons Construction Co. of Denver

A Colorado Central Mix Plant

By Henry M. Roberts

Secretary, The J. Fred Roberts & Sons Construction Co., Denver, Colo.

THE accompanying illustration gives an idea of the essential features of a central mixing plant that has been used for some years by The J. Fred Roberts and Sons Construction Co. of Denver, in their operations on Colorado highway concrete paving projects. This plant was originally erected for use on a city concrete paving and curbing project, on which some 13,000 cubic yards of concrete could be placed with a maximum haul of about 2,000 feet from a central plant. It was subsequently found to operate with reasonable success on strip jobs for the Colorado State Highway Dept.

Essentially the installation consists of a Smith 21-S tilting mixer on skids, with batch-hopper, together with timber storage bins for fine and coarse aggregate, and three belt conveyors for the elevating of the aggregates and cement. The head end of the cement conveyor, which discharges onto a platform above the mixer, can be seen at the right of the aggregate bins. The boot of this conveyor is located within the cement storage house in the rear, and closely adjacent to the railroad switch, in such fashion as to be conveniently loaded from either a cement car on the track, or from storage within the house.

All operating levers are banked on the platform above the mixer, so that the operation of charging and discharging the mixer, charging the batch-hopper with sand and gravel, and adding water, are handled by one operator. The second man on the operating platform receives the cement at the head of the cement conveyor, opens bags, and dumps the necessary five bags for each batch, into the batch-hopper.

Loading traps that are flush with the ground are located over the boot pulleys of the sand and rock conveyors.

Sand is generally obtained locally, delivered by truck, and fed to the conveyor by one man and a 2-horse fresno. When coarse aggregate is delivered by truck, it is similarly handled to the coarse aggregate conveyor. When coarse aggregate moves in on railroad cars, it is unloaded by a small steam crane which dumps directly into the trap.

The theoretical maximum output of mixed concrete, with a minute and a half mix, is 215 cubic yards in nine hours. The operation of the plant has shown a satisfactorily close approximation to theoretical maximums over long periods of use.

The usual operating crew for such output consists of nine men, including plant foreman and night watch, and team and fresno and one steam crane. Daily operating expenses on this basis will figure not far from 35 cents per cubic yard of mixed concrete from railroad cars into trucks. This figure, of course, includes no plant installation charge.

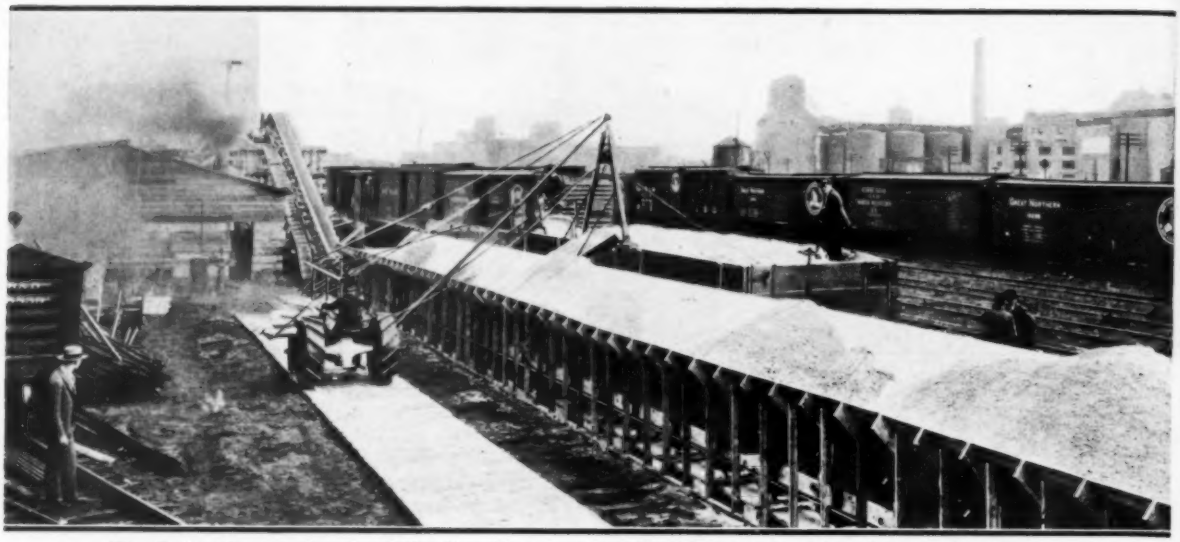
The mixer does not carry its own power unit, but is equipped with belt pulley and is belted to the central source of power for the entire plant. Both internal combustion engines and electric motors have been successfully used as power units.

Two of the largest projects handled by this installation have shown consistent and satisfactory performance, with only a Fordson tractor turning both the mixer and the conveyor system. The load under these circumstances, however, so closely approximates the peak capacity of the Fordson tractor in excellent condition, that where the condition of the latter is doubtful, it has been found expedient to load it with the mixer only, and drive the conveyor with a 10 h.p. Novo engine.

The installation is adaptable to any method of delivery of cement, sand and rock, except conditions where all three reach the mixing site in railroad cars. When this is the case it would be difficult to avoid congestion of cars.

Time and labor involved in the erection and lining up of the plant is an admitted drawback. The shortest time yet obtained in tearing down and re-erecting on the same job has been ten days from the time of mixing the last batch at the old site until the mixing of the first batch at the new site.

A 5-ton Universal Motor Truck Crane with a 52-foot Boom Owned by Vogt & Conant, Cleveland, Ohio, Showing Its Versatility in Building Construction



The Fegles Construction Co. Unloading Plant on the Union Elevator Co. Job in Minneapolis, Minn.

An Effective Unloading Layout

WHEN the Fegles Construction Co., Ltd., 529 South 7th Street, Minneapolis, Minn., contracted to build an elevator for the Union Elevator Co., in the Great Northern freight yards in Minneapolis, it found itself cramped for space for its construction plant. The plot was entirely surrounded by trackage, making it necessary to ship all equipment to the job on flat cars. After the foundation had been poured and a small cement storage house built, only a triangular space about 100 feet long and 30 feet wide at its broad end, remained for unloading and storing materials to be used on the job. It was necessary to unload 6 to 8 cars of sand and gravel per day. To move a crane to the job would have been a large expense item in itself and, even if the crane were there, the storing of the material and transporting of it to the mixing plant would have been rather difficult.

The problem was solved in an interesting manner by Ben Sahf, Superintendent on the job for the Fegles Construction Co. A long hopper was built the full length of the trackage into which the material was dumped and then conveyed to the mixing plant on a gas-engine-driven belt conveyor. A Fordson tractor equipped with a Model-B Baker car unloader, built by the Baker Steel & Machinery Co. of Omaha, Nebr., was purchased and a runway laid along the hopper to assure good footing for the tractor. As the Fordson carries the A-frame, it was only necessary for the operator to drive up to the empty part of the conveyor, lower the A-frame to the side of the car on the other side of the conveyor and go to work.

Only a few hours each day are devoted to unloading sand and gravel. The remainder of the time the outfit is used as a light portable crane. This is done by removing the A-frame from the end of the boom and telescoping the boom to its 12-foot length. A casting on the end of the boom supports a sheave block carrying a cable which attaches to one of the drums of the Baker double-drum winch. The outfit is then put to work unloading and piling bulky materials from cars spotted on the trackage opposite the long hopper.

F. C. Rowell, Research Engineer, Boston and Maine Railroad, Driving the First Pile for the New North Station, Boston, on December 10, 1927. This New Structure Is to Include not Only the Train Shed and Offices but a Large Athletic Plant Rivaling New York's Madison Square Garden. Mr. Rowell, as Assistant to the Chief Engineer when the Original North Station Was Built in 1892-93, Had Charge of Much of the Construction Work at That Time.

There is a direct relationship between an orderly job and accident prevention. A well-kept operation with well-disciplined workmen enhances prevention of injury. A poorly organized job encourages accidents.

Legal Points for Contractors

These brief abstracts of court decisions in the contracting fields may aid you in avoiding legal difficulties. Local ordinances or state laws may alter the conditions in your community. If in doubt consult your own attorney

Edited by A. L. H. Street, Attorney-at-Law

When the Contractor Is Deceived

A CONTRACTOR asks us to discuss legal phases of the following stated case: After a contractor entered into a building agreement he was taken ill and work under the contract was entrusted to his superintendent. Redrafting of the plans became necessary, because the originals were found to violate a local building ordinance.

In the meantime, the excavation had been completed and rains caused it to fill and partly cave in. Later the work progressed rapidly but the contractor, on convalescing, discovered that the owner was getting a better building than he was entitled to under the contract. Responsibility for changes in the working plans batted back and forth between the owner and the architect, while the contractor suspected that both of them were in collusion to defraud him.

1. Is either or both the owner and his architect criminally liable?

2. Do unauthorized changes made by them, or either of them, nullify the original contract?

1. It is doubtful that the ordinary criminal statute against frauds and false pretenses would reach such a case as is here assumed to exist. That is a matter that should be determined on consultation with the local prosecuting attorney and other counsel. Our inclination is to advise the contractor against instigating a prosecution. Having people arrested is dangerous business, for they are almost sure to come back with a suit for damages as for malicious prosecution on being acquitted. We assume that either or both the owner and architect are good for judgment for damages. If so, a claim for damages should give the contractor all the satisfaction his heart desires.

2. On discovering that the owner, or the architect acting for the owner, has fraudulently caused changes to be made in the plans to secure something to which the owner is not entitled under the contract, the contractor can abandon the work and sue for the full value of the work and labor furnished. If the changes from the contract plans are of such nature as to so merge the contemplated work that it is not possible to allow the contractor the *contract price* for the work originally contemplated, plus the *fair value* of the additional work, then he may insist on the original contract price being disregarded, and can hold the owner liable for the value of the whole job. But if it should be a case of additions, rather than substitutions, the contractor's recovery would properly be measured by the contract price for the part of the work covered by the original contract, plus the reasonable value of the additional work.

On the facts stated, it looks very much as if the contractor's own superintendent was asleep on the job, for it would seem that he should have maintained some sort of check of the plans furnished by the architect as the work progressed against the plans called for by the contract.

It is probable that the contractor would have a valid claim for damages against the owner on account of damage done to the excavation as a result of the owner's delay in furnishing the necessary plans. But, while that claim could be well hitched to the claim for extra work, it would hardly justify litigation independently.

Damages Through Delayed Performance Were Not Proved

"You owe us $6,000, as a balance due for marble installed on that bank job you sublet to us," said a subcontractor to the general contractor.

"We can't see it that way," replied the general contractor. "You did not complete the work within the time you said you would. That delayed completion of the building, and the owner's architect is holding back $6,000 as security for an adjustment of the owner's claim for damages."

A flock of lawyers was called in, but that failed to bring about an amicable adjustment, and a lawsuit followed.

The United States District Court for the Western District of Washington, Northern Division, decided that the general contractor was right in its contention. The subcontractor was not convinced, and appealed to the United States Circuit Court of Appeals, Ninth Circuit, and won a new trial. In a decision handed down by that court June 27, 1927 (Mission Marble Works vs. Robinson Tile & Marble Co., 20 Federal Reporter, 2d series, 14), it was held that the general contractor failed to prove that it had definitely sustained the loss covered by its counterclaim. The court said:

"Ordinarily the damage for delay in constructing a building is measured by its rental value for the period of that delay. . . . 'Where a builder delays the construction of a building and the owner is thereby compelled to continue his occupancy of, and to pay rentals for, leased premises, the amount of such payments may well constitute the real injury arising from the breach of the contract. . . . If it be shown that the continued occupancy of the leased premises resulted in savings to the defendants in the expenses of operating their business, such savings should be offset.' . . . .

"It is well settled that proof of damages must be reasonably definite and certain. The contract between the bank and the defendant [the general contractor] did not vest power in the architect to determine any question of damages to the bank for delay or to withhold payment on account thereof. The architect's authority was limited to computing the amounts payable in installment each month, the remainder to be paid upon his certificate that the work was satisfactorily completed and a showing that all claims had been paid. . . . .

"It is to be borne in mind that the bank is not a party to the present action, and that there has been no settlement of the question of damages between the defendant and the bank. Indeed, it is not established that the bank will ever claim damages against the defendant. . . . . The defendant can claim damages against the plaintiff only on the theory that it has paid, or will be compelled to pay, damages to the bank."

Ordinance Fixing Wages on Public Works Adjudged to Be Void

The city of Atlanta passed an ordinance declaring it to be to the public interest that a minimum wage scale be fixed for work done upon or in the construction of public buildings and bridges and repairs thereon. In line with this policy, the following scale of hourly wages was ordained on all work done by the city itself or by contractors holding contracts for work: Blacksmiths, 90 cents. Carpenters, painters and sheet metal workers, 80 cents. Bricklayers, $1.40. Plasterers, plumbers, and steam-fitters, $1.25. Electrical workers, lathers, and hoisting engineers, $1.00. Elevator constructors, $1.18. Stone cutters, $1.12½. One section of the ordinance declared that failure of a municipal contractor to pay the stipulated wages should invalidate his contract.

The validity of this ordinance was successfully assailed in the case of Wilson vs. City of Atlanta, 139 South Eastern Reporter, 148. The Georgia Supreme Court holds that the ordinance is void as tending to defeat competition for public contracts, thereby burdening taxpayers, and that contracts made in pursuance of the ordinance are invalid.

A Contractor Was Not Liable for a Danger Created by a Defective Building Plan

An Indiana school district trustee approved building plans which omitted provision for any sort of guard-rail around an areaway constructed to afford outside access to a basement. Following the plans, the contractor merely provided a curb three inches above the ground around the areaway. After the job was completed and accepted and the building was being used for school purposes, a pupil, in playing, was pushed into the areaway and injured. Suit against the trustee, the architect and the contractor followed, but the Indiana Appellate Court decided that there was no liability. (Sherman vs. Miller Construction Co., 158 North Eastern Reporter, 255, decided October 11, 1927.) As to the construction company, the court said:

"It performed its contract for the construction of said building according to the agreement in that behalf; the plans and specifications for said building had been approved by the township trustee, the officer ordained by law to perform that duty, and it was not for it to question the judgment of the trustee in that behalf."

Refusal to Work is Not a Strike

Schaefer, a contractor, was suspended from an association of contractors. Thereupon, his union employes quit his service and he could not secure substitute labor. He had undertaken a job and given a bond to complete the contract but abandoned the work. Suit against his surety was defended on the ground that non-performance was excused, since the bond provided that the surety should not be liable for damages resulting from "strikes or labor difficulties." But the Washington Supreme Court decided (Unden vs. Schaefer, 188 Pacific Reporter, 395, March 22, 1920), that the provision of the bond did not fit the case. The court said:

"In the common acceptance of the term, it is not a 'strike' for the workmen of an employer to quit his employment and go elsewhere, without any intention of returning; nor is it a 'strike' for workmen to refuse to enter into the employment of a particular contractor. A 'strike,' in such common acceptance, is the act of quitting work by a body of workmen for the purpose of coercing their employer to accede to some demand they have made upon him, and which he has refused; but it is not a strike for workmen to quit work, either singly or in a body when they quit without intention to return to the work, whatever may be the reason that moves them so to do. It is a matter of common knowledge that during the late war period many employers of labor, because of the great demand for labor had difficulty in employing and keeping a sufficient number of workmen. . . . No one, however, supposed that the quitting of these workmen constituted a 'strike.' Schaefer's situation here was not different. By his own act he had placed himself in a position where certain workmen could not remain in or enter into his employment without violating their agreement, and others he could not obtain, and in no sense can this be denominated a strike.

"The addition of the phrase 'labor difficulties' to the term 'so-called strikes' does not enlarge the meaning of the latter. It is rather definitive than expansive of it. In other words, the phrase is but explanative of the meaning of the word 'strike,' and any act of the workmen which would not constitute a strike would not constitute a labor difficulty."

Liability of Owner Where Contractor Justifiably Abandons a Job

In the case of Decatur County vs. Praytor, Howton & Wood Contracting Co., 137 South Eastern Reporter, 247, decided by the Georgia Supreme Court March 5, 1927, it appeared that a county bridge contractor rightfully withdrew from the contract on discovering that the county had misrepresented the river bed conditions. The principal question in the case was as to how the contractor's damages recoverable against the county should be measured. On this point the court said:

"Is the county liable merely for the difference between the contract price of the work actually done and the materials actually furnished and the amount paid thereon, or is the county liable for the entire profits which the builders would have received for the completion of the bridge under the contract? It is earnestly insisted by counsel for the builders that they are entitled to recover the full contract price for the building of this bridge, if they are prevented by the county from completing it. . . . . We fully agree that a party is entitled to recover all damages which he actually sustains, if he is prevented from performing the contract by the act of the other party, and if he offers and stands ready to fully perform himself. There is a great difference between actual performance and excuses for non-performance. . . . . If a party to a contract is prevented from performing it by the other party thereto, and if the party not in default offers and stands ready to perform the contract, in such case he would be entitled to recover the full contract price. If, however, the contract is expressly or impliedly rescinded by the parties, or if the builders are entitled to have the contract rescinded, and treat it as rescinded, such rescission, in the absence of an agreement fixing the rights of the parties, leaves the rights and the amount of the damages, if any, to be determined, not by the contract, but upon equitable principles. . . . . Where the contract is entire, and full performance by the builder is excused by reason of the wrongful acts of the owner, the builder may sue on the contract to recover for the work done according to the contract, and for the loss in profits or otherwise, sustained by him; but, if he treats the contract as rescinded and at an end, he can sue and recover the full value of the labor done and materials furnished in the partial performance of the contract, less payments made thereon. In these latter circumstances, he is entitled to the compensation provided for in the contract, so far as he has performed the work and furnished materials. . . . . The fact that full performance of the contract is prevented by the wrongful act of the owner does not necessarily entitle the builder to recover the compensation provided for in case the builder fully porforms the contract. . . . . Where the builder is excused from fully performing the contract by some wrongful act of the owner, and he treats the contract as at an end, he is entitled to the compensation provided for in the contract, so far as he has performed the work, and no further."

Submit your Legal Problems to Contractors and Engineers Monthly. Citations are furnished free to Subscribers

Construction Industry News

The American Cable Co., 215 N. Michigan Avenue, Chicago, Ill., has been awarded the contracts for the wire entering into the cables and suspender ropes of two suspension bridges to be built soon. The Detroit International Bridge, over the International boundary line between Detroit, Mich., and Windsor, Canada, will be approximately 1.7 miles. The main suspended span will be 1,850 feet, or 100 feet longer than the Delaware River Bridge at Philadelphia, Pa., at present the longest suspension bridge in the world. This bridge will be completed in August, 1930. The bridge to be built over the Mount Hope Bay at Bristol, R. I., will have a capacity of 3,000 cars an hour and will provide a direct highway route of 28½ miles from Newport to Providence. The main suspended span will be 1,200 feet.

The American Carbolite Co., Inc., Duluth, Minn., beginning January 9, 1928, is merchandising the entire output of the Carbic Manufacturing Co. The American Carbolite Co., Inc., has appointed the Oxweld Acetylene Co. its exclusive agent for the sale of Carbic lighting, welding and cutting equipment and the Union Carbide Sales Co. its exclusive agents for the sale of Carbic cakes. The address of both sales agents is New York City.

The American Vibrolithic Corporation, Des Moines, Ia., has announced the appointment of M. Russell Thayer as Consulting Engineer, operating in all territories, with headquarters in Des Moines. Mr. Thayer is well qualified for his new duties, having joined the Vibrolithic organization in 1921 as Consulting Engineer, operating in Illinois territory, and having a background of training and experience, and intimate association with concrete construction, both in the laboratory and field since the pioneer days. Mr. Thayer has had a wide experience in railroad construction and maintenance work, has conducted wide investigations in water-bound macadam roads and concrete highway bridges, portland cement concrete pavements and metal-surfaced highways, with the Illinois Highway Department, and several railroads.

The Bates Valve Bag Corp., 35 East Wacker Drive, Chicago, Ill., has announced the construction of a new factory at Birmingham, Ala., for the purpose of supplying the rapidly increasing demand in the South for Bates Multi-Wall paper bags for cement, plaster, and lime.

The Construction Machinery Co., Waterloo, Iowa, has announced the appointment of Charles E. Funk as Eastern Sales Manager with headquarters at 236 North 23rd Street, Philadelphia, Pa. Funk has been connected with the company for fifteen years and has had many years of field work among equipment dealers.

The Hawkeye Maintainer Co., Waterloo, Iowa, has announced that L. A. Kliebenstein, formerly Vice-President in charge of sales of the Construction Machinery Co., Waterloo, Iowa, is now associated with the Hawkeye organization.

The Hercules Motors Corporation, Canton, Ohio, at its annual stockholders' meeting, reelected the following directors: H. H. Timken, President, Timken Roller Bearing Co., Canton, Ohio; R. W. Gallagher, President, East Ohio Gas Co., Cleveland, Ohio; E. A. Langenbach, Canton, Ohio; G. M. Mather, President, Mather Spring Co., Toledo, Ohio; and Charles Balough, Vice-president and General Manager, Hercules Motors Corporation. The business of this company has grown steadily during the past several years, and an increased dividend payment of 33 1/3 per cent over 1926 and 100 per cent over 1925 on the capital stock was announced recently.

The Hunter Machinery Co., with offices and warehouses in Detroit and Grand Rapids, Mich., has been appointed distributor of pile hammers within the state of Michigan for The McKiernan-Terry Drill Co., 15 Park Row, New York.

The National Equipment Corporation, a Delaware corporation, has been organized by Milwaukee financial interests for the purpose of purchasing and holding a controlling interest in several non-competing construction equipment companies in various parts of the country. The new corporation already holds an option for the purchase of a controlling interest in the T. L. Smith Co., Milwaukee, Wis., manufacturers of concrete mixers. Among those interested in the new holding company are Harold E. Smith, President, the T. L. Smith Co., Philip Koehring, President, the Koehring Co., Jos. E. Uihlein, Robert Uihlein, and other Milwaukee financial interests. The officers, directors and management of the T. L. Smith Co., will continue as heretofore. The company will be operated on a more vigorous scale than ever. Harold E. Smith will continue as President in active charge of the T. L. Smith Co.

The Reed-Prentice Corporation, Worcester, Mass., manufacturer of machine tool equipment and the Wolf portable timber sawing machine, has announced the appointment of George W. McIntyre, 75 West Street, New York, as its representative in the New York territory.

The Gustav Schaefer Wagon Co., suffered the loss by fire of its Plant No. 1 and offices at 4180 Lorain Ave., Cleveland, Ohio, on Thursday evening, December 29. This factory was established in 1880 and had an unbroken record of no fires throughout 47 years. Temporary offices have been established at 4200 Lorain Avenue and Plant No. 2 about one mile south on the Big Four Railroad is in full operation.

The Superior Supply Co., equipment distributor, 1836-60 South Kostner Avenue, Chicago, Ill., has announced that S. J. Cogan has been appointed Assistant Sales Manager in charge of field operations.

Charles M. Upham, Business Manager, American Road Builders Association, has announced the opening of the offices of the Highway Engineering Bureau in the National Press Building, Washington, D. C. This Bureau offers consulting services in highways, transportation and associated industries. Charles M. Upham is President, Fred E. Schnepfe, Vice-president, and the associated advisory engineers are Albert T. Goldebeck, Director, National Sand and Gravel Association; Prevost Hubbard, Chemical Engineer, the Asphalt Association; Fred A. Reimer, Consulting Civil Engineer, East Orange, N. J.; Henry G. Shirley, Chairman, State Highway Commission, Richmond, Va.; William A. Van Duzer, Deputy Engineering Executive, State Department of Highways, Harrisburgh, Pa.; Dr. J. A. L. Waddell and Shortridge Hardesty, of Waddell and Hardesty, Consulting Engineers, New York City; Earl Stafford, and Maurice Holland.

The Geo. D. Whitcomb Co., Rochelle, Ill., has appointed Ralph Rollins, formerly with the Easton Car Construction Co., of Easton, Pa., its representative in North Carolina, South Carolina and southern Virginia, with headquarters at 1206 Commercial Building, Charlotte, N. C.

S. M. Williams, who has been connected with the Autocar Sales & Service Co., 1716 West Pershing Road, Chicago, Ill., is now in charge of the Highway, Public Works, and Railroad Divisions of the Association General Contractors of America. His new address is Room 1150 Munsey Building Washington, D. C. Mr. Williams has been one of the most active men in the road building industry, and is well known for his work on the Standard Questionnaire for the rating of contracts.

High Lights of the Road Show

DURING the week of January 9-13, Cleveland, Ohio, was the host of some 22,000 contractors, engineers and others interested in the great industry of road building. The spacious Public Auditorium with its Arena Exhibition Hall, New Exhibit Hall, Esplanade, West Wing and Central Armory, housed over $3,000,000 worth of road machinery and materials. The Road Shows of the last few years in Chicago were great, but the Cleveland Show surpassed all. Everywhere there was evidence of better organization and greater comfort.

In the first place, the exhibit space available was much larger than that furnished by the Coliseum and its adjacent buildings in Chicago. Much wider aisle space was provided in Cleveland, making it possible to move with considerable celerity from one portion of the Show to another. The vast exhibit was well-distributed, but it was not too far distant from any one part to the most distant section. The only crowding occurred in the Esplanade leading from the Arena to the West Wing, where two particularly attractive exhibits caused the crowd to pause. One of these, a model demonstration of a rotary snow plow for country highways coupled with motion pictures showed the full-size machine in use. On the opposite side of the aisle was the always interesting exhibit of a prominent pneumatic tool manufacturer whose clay spaders, tampers and drill-heating furnaces caught the eye of the visitor.

The main arena of the Public Auditorium housed many large machines, together with full-size storage bins and batcher plants, as well as power shovels, power excavators and engines. In the lobby surrounding the Arena were rest rooms for state highway officials, county highway officials, highway contractors, and city officials, as well as many of the smaller, though no less interesting, exhibits.

Particular mention should be made of the army of cleaning women who were always on duty, but never in the way. Rubbish was quickly removed from booths and aisles, so that the Show maintained a cleanly appearance from the moment the doors were first thrown open until the closing hour on Friday.

The West Wing housed many exhibits of trucks, tractors, some concrete machinery, gasoline locomotives, wagon loaders, and road rollers. From the West Wing parties were made up to travel by de luxe bus to the plant of the Cleveland Tractor Co. and the White Co., where the manufacture of tractors and motor trucks, respectively, could be inspected.

Of particular interest were the small signs appearing on various pieces of equipment showing the auxiliaries used, including the powerful gasoline engines, roller bearings, pressure lubrication, radiators and magnetos.

The outdoor show where machines were operated under their own power, instead of by electric motors as they were inside, included snow plows, tractor bins, batchers, trucks and snow loaders.

The Exhibition Hall beneath the Arena, and of the same size, had many novel exhibits. Among the most interesting was that of a shovel company where its own shovels were tested to destruction to show the punishment they would withstand. There were also exhibits of pumps, concrete and asphalt paving, graders, engines, compressors, and concrete surfacers.

In the New Exhibit Hall adjacent to the Exhibition Hall, there were shown trucks, chip spreaders, vacuum street cleaning equipment, a dry battery electric flashing traffic signal, metal troughs for spanning mud holes in roads and hydraulic jacks for trucks.

In the Armory, where the railroad tickets were validated for the one-half fare return trip, power shovels, loaders, graders, tractors, concrete mixers, reflector traffic signs and midget portable pumps were exhibited.

For those with a keen desire to guess the correct figure and win a prize, one of the large power shovel companies offered an opportunity to guess the price of a new power shovel and in another section a concrete cart continued to tip at regular intervals throughout most of the Show, and an opportunity was given to guess the number of times the cart tipped during the week. Announcement has been made that the number was 35,929. The buggy was bronzed and mounted on a platform, and electrically driven to dump back and forth. Prizes were awarded for the three guesses nearest to the correct number. The first prize, a sole leather traveling bag, was won by Theodore Helsing, 426 Neville Street, Pittsburgh, Pa., whose guess was 36,000. The second prize, a "zipper" locker bag, was awarded to Carl A. Gregory, associated with the James H. Herron Co., heat treaters and metallurgists of Cleveland. The third prize, an imported auto robe, went to "Salesman Sam" Irvine of the Harvill Supply Co., Nashville, Tenn. The second and third estimates were 35,843 and 36,111.

According to Charles M. Upham, Business Director of the American Road Builders' Association, there was a total registration of 22,000 at the 1928 Road Show, and the attendance at the Convention sessions varied from 400 to 900. It is interesting to note that 92,000 square feet of exhibit space was used at the Road Show in Chicago in 1927, while the exhibit space at this year's Cleveland Show was 155,000 square feet, and much more space could have been used, had it been available.

Wood Carving of King Nebuchadnezzar

ONE of the most interesting exhibits at the Road Show was one with an historical background. The Asphalt Association showed a wood sculpture of King Nebuchadnezzar of Babylon dedicating the first asphalt highway. This

The Asphalt Association Wood Carving of King Nebuchadnezzar

king ruled between the years 604 and 582 B. C. The road which he is depicted as dedicating is Procession Way, the first pavement in which asphalt was used. He is dedicating it to his gods Nabu and Marduk and to the memory of his father. Nebuchadnezzar is seen standing at the highway's entrance, the tower of Ishtar Gate, a portion of which still stands.

The fantastic animal seen on the wall of the tower represents Sirrush, companion of Marduk. The face and the helmet of the king are represented according to a recently discovered seal published by Max Kielmann in Stuttgart, Germany, in his book "Die neuren entdekungen und die Bibel." According to the artist, V. B. Verevkin, this is so strikingly different from all illustrations hitherto conceived in portraying the famous ruler of the second Babylonian Empire that it is likely to arouse criticism in the artistic world.

New Gasoline Engine Offered for 1928

A NEW single-, a new 2-, and two new 4-cylinder gasoline engines have been added to the line of Novo Rollr industrial engines in 1928, according to the Novo Engine Co., Lansing, Mich. The Novo 2-cylinder Rollr engine, an 8-horsepower unit, designated as Model-HU, was offered in January. It has a 3 3/16-inch bore and a 4-inch stroke and will be similar to the 6-horsepower VF engine. This group now consists of 6-, 8-, 10- and 12-horsepower engines which are available in both radiator and hopper-cooled types.

The two new single-cylinder engines will be similar to the

One of the New Novo Rollr Gas Engines

Novo line of 2-cylinder engines in appearance, but they will be smaller. The cylinder block will be shorter than the 2-cylinder Rollr engine. These will be manufactured in 3- and 4-horsepower sizes and will have Timken roller bearings for the crankshaft and will be equipped with a high-tension magneto giving a hot spark at any cranking speed, positive lubrication, and will give more power in less space, according to the manufacturers.

The 4-cylinder engines, also of the Rollr type will be 12-, 14- and 16-horsepower units. These engines will have Timken roller bearings on the crankshaft and power drive shaft, will have double 180-degree throw crankshafts, large hand-hole plates, making the inside of the engine accessible, positive-driven oil pump to insure proper lubrication, speeds from 1200 to 1800 r.p.m., giving a drive shaft speed of 300 to 1200 r.p.m. and will drive from either end. The manufacturers state that these engines are so flexible and smooth in operation that they are suitable for running practically all types of construction equipment within their horsepower range.

The New One-yard Power Shovel with Single Line Hoist Developed by the Ohio Power Shovel Co.

A Shovel, Crane and Dragline

ONE of the latest additions to the line of power excavating equipment is a 1-yard shovel with a single line hoist. The new machine is a product of The Ohio Power Shovel Co., Lima, Ohio, and can be converted into a clamshell, dragline or pull shovel. Gasoline, diesel or electric drive is supplied as desired.

This new piece of equipment embodies many radical departures from the conventional design, chief of which are the use of Timken roller bearings instead of bronze sleeve or babbitt, and the single line hoist. The use of roller bearings has practically eliminated friction and leads to great speed combined with tremendous power and smoothness. Maintenance costs are low, since the roller bearings need lubricating about every six months instead of two or three times a day. Bearing adjustments are seldom necessary, and according to the manufacturers, with ordinary care one set of bearings should outlast the machine.

The use of the single line hoist allows a higher lift and greater reach. The cable cost is low as a short, sturdy wire rope traveling very slowly is used.

Shovels under test for two years have shown tremendous yardages in such hard digging as brick shale, slate, hard pan, etc. Four passes a minute can be maintained indefinitely without fatigue to either the operator or the machine. Because of the elimination of friction by the use of roller bearings, the gasoline consumption per yard of dirt moved is very low.

Three-lever control is used, the position and throw being so arranged that any steam shovel operator can get maximum yardage in a very short time. Independent control of the dipper crowd is another feature. An all gear, propelling drive is used with all driving gears under the truck enclosed in oil tight cases.

Hey! Teacher

Bobby's father was a highway engineer. His teacher, failing to get a satisfactory answer from several in his class in the defining of "cement," sought Bobby's assistance and received the following reply:

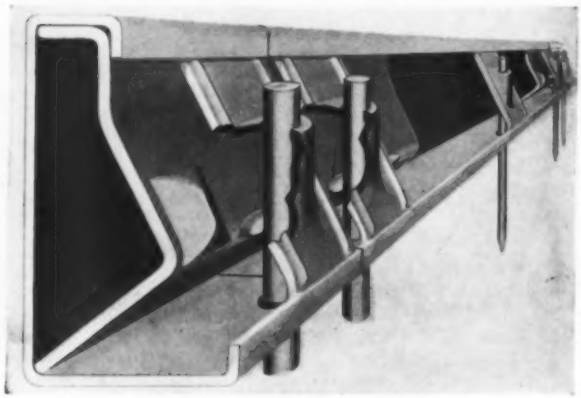
"Cement is the product obtained by finely pulverizing clinker produced by calcining to incipient fusion an intimate and properly proportioned mixture of argillaceous and calcareous materials with no addition subsequent to calcination except water and calcined or uncalcined gypsum."

California Highways

Accident prevention in the construction industry is very largely a matter of education, vigilance and cooperation.

New Road Form for Heavy Road Machinery

SOME time ago J. N. Heltzel, President, the Heltzel Steel Form and Iron Co., Warren, Ohio, prophesied that the day was not far distant when the weight and thrust of heavy road machinery would compel the complete redesign and reconstruction of steel road forms. In announcing a new road form of a distinctly different type from any heretofore developed, Mr. Heltzel states that he believes the day has arrived and that this present form will stabilize the heavy construction equipment which runs on the road forms.



The New Heltzel Steel Road Form

This new road form is made of 3/16-inch special steel plate with double reinforcing flanges and a 6-inch base. It follows the same general design as the Heltzel road rail. Heavy steel stake pockets are welded to the two rail flanges, and 1-inch round steel stakes are used with an angular shape steel joint lock made of ¼-inch steel plates. This stake lock wedges between the stakes and the face of the rail with one leg of the lock wedging against the intersection of the face and to top of the rail and the other leg wedged against the inner section of the face and the base of the rail.

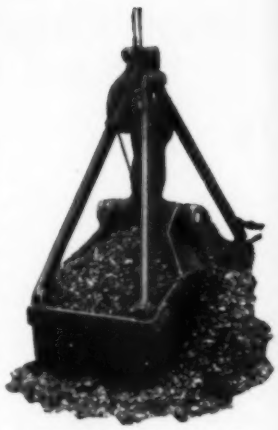
Two wedge-shaped swells are pressed into the stake lock wedge, one against either stake, making a positive locking arrangement, and a larger swell pressed into the stake lock serves as a releasing lug, which when tapped with a sledge unlocks the form.

This joint locking arrangement not only locks the forms, but automatically aligns the rail ends and holds them rigid. From the standpoint of setting or stripping the forms, the simplicity of these operations is noticeable. The form is a complete unit, with the stake lock at one end of the rail having no separate parts, excepting the two stakes.

To set the forms the rails are butted end to end, the joint lock placed in position and the stakes driven. One top with the sledge locks the forms and aligns the rails.

Employers and workers should increasingly realize that it is to their mutual interest to have industrial production with safety.

A Bucket for Material Handling



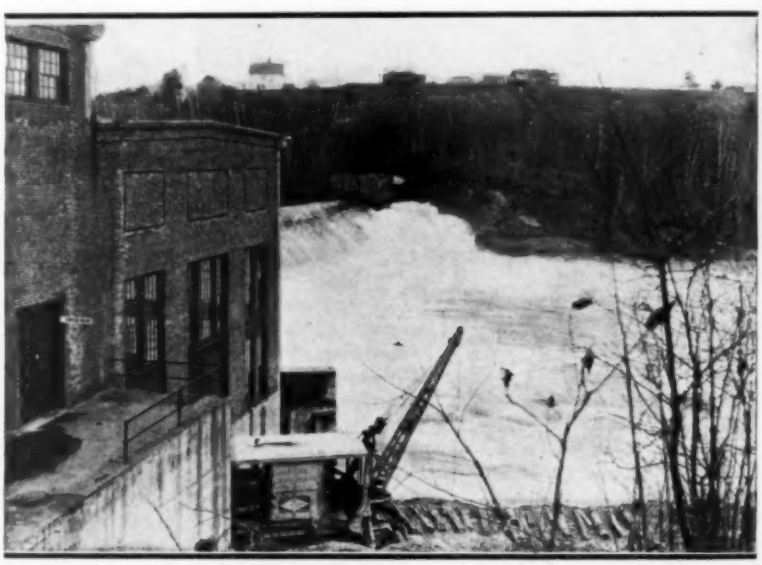
A Williams "Favorite" Clamshell Bucket

THERE are many types of service in which clamshell buckets are used. Contractors can seldom afford to purchase a dozen different types of buckets in various sizes but rather they choose the type that is adapted to the cranes they own and the general service required by their contracts. The "Favorits," a ½- to 3-yard bucket developed by the G. H. Williams Co., Erie, Pa., is used by contractors who have considerable light excavation and much material handling. This bucket was designed with these features in mind. It handles the medium classes of excavation and is fast enough for rehandling sand, gravel, stone and other materials up to 3 inches in diameter.

This bucket is reeved with a 4-part closing line for excavating and can be changed to a 3-part line for greater speed in opening and closing for material handling. It will operate with any equipment having two drums for bucket operation. The scoops of this bucket are claimed by the manufacturer to be from ⅛- to ¼-inch heavier stock than for other buckets offered for similar work. It is built with heavy 1-piece forged corner bars meeting at the top to form a narrow rigid head. It is built entirely of steel.

William M. Ballard, general contractor, Syracuse, N. Y., reports that with a 2-yard Favorite bucket his outfit has unloaded as many as 26 cars a day.

An Aftermath of the New England Flood

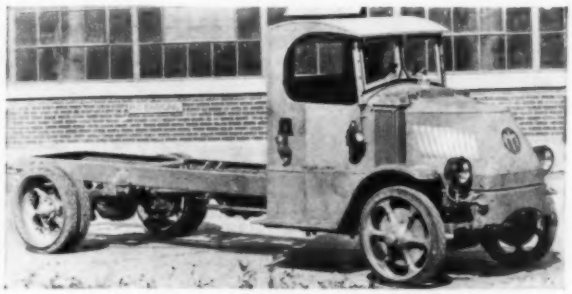


A Bay City 16-B, ¾-yard Convertible Excavator, Owned by R. G. Watkins, Contractor, Amesbury, Mass., Cleaning Out the Tail Race of the Hydro-Electric Plant of the Boston and Maine Railroad Near Franklin, N. H. The Tail Race of the Power Plant Became Completely Choked Up from the Wash During the Flood on the Pemigewaset River, so that it was Necessary to Place the Crane Along the Banks to Remove It. The Excavator, with a 35-foot Crane Boom and a ½-yard Clamshell Bucket, Ran on Railroad Ties Laid Along the Bank in Front of the Machine, to Prevent the Weight of the Machine Causing the Bank to Crumble as it was Badly Undercut. The Machine Weighs Approximately 20 Tons

A New High-speed, Heavy-duty Truck

THE field of heavy tonnage carrier equipment has had added to it a new high-speed, heavy-duty truck, a product of Mack Trucks, Inc., 25 Broadway, New York. This Model-AK is a distinctive unit that has speed and control possibilities of value to the contractor and road builder, and it has a capacity of 3½ to 5 tons, with 162-inch, 174-inch and 186-inch standard wheelbases.

Many of the well-known Mack "Bulldog" features are found in this new truck. These features include the heavy-duty, 4-cylinder engine with 3-point suspension, heat-treated, semi-steel clyinders, drop-forged and case-hardened crankshaft having 3-inch diameter journals and the Mack type of force-feed and splash lubrication. Then there is the usual Model-AC "Bulldog" hood with tubular radiator in cowl, the beltless blower-type fan all mounted in the rear of the engine, the Mack water pump of the balanced bronze rotor-type, the large, single-disc-type clutch, and transmission with 4 speeds forward and one reverse with gears mounted on a patented in-



The New Model-AK Mack Truck for Heavy Haulage

terrupted spline shaft. In addition to the special dual-reduction drive, the standard Model-AC chain drive is also offered on the Model-AK.

The engine of 4⅝-inch bore and 6-inch stroke has cylinders cast en bloc with detachable aluminum heads. The transmission is suspended in 4 blocks of live, resilient rubber held under compression. Springs are rubber shock insulated, reducing vibration to a minimum and also eliminating entirely the lubrication problem of the metal shackles.

Four-wheel brakes of the internal-expanding type are standard. The emergency brake operates mechanically and is of the external-contracting type. On the chain-drive model, it is located on both jackshafts, while on the dual-reduction model, it is mounted on the rear end of the transmission.

This new truck has a sharper turning circle than ever before offered on this make of truck, being effected by center-point steering which makes for exceptionally easy handling in traffic.

A 40-gallon gasoline tank is mounted under the driver's seat with the filler opening through the right side of the cab. The cab itself is all steel with sliding doors and is mounted in rubber shock insulators. In addition to shock insulating the cab, the seats themselves are mounted in rubber.

A New Fine Reducing Crusher

ASIDE from making many improvements in its general line of crushers such as eliminating cast iron castings, using twin bearings in place of single bearings, etc., the Good Roads Machinery Co., Inc., Kennett Square, Pa., has announced a new 10- x 30-inch fine reducing crusher operated entirely on Timken roller bearings and SKF bearings. Following the general design of the Champion line, this crusher has a built-up frame.

The New Champion Portable Crusher and Sand and Gravel Plant

In conjunction with this crusher, a portable sand and gravel plant, self-propelled, and capable of being operated directly in a gravel pit and readily moved to keep close to its work, is being developed. The portable plant comprises, aside from the crusher, two sets of conveyors, a shaker screen, hopper and grizly, all mounted on a rubber-tired roller-bearing chassis, propelled by a 4-cylinder gasoline motor. This machine has passed through the development stage and is now in production.

In addition to these two new developments, the Good Roads Machinery Co. has recently brought out a larger cast-iron frame crusher, known as the No. 3½ Climax. This crusher has an opening of 12 x 26 inches and has been popular in certain fields as a primary crushing unit.

A Gasoline Concrete Breaker

A NEW labor-saving device in the form of a gasoline hammer made for breaking up concrete and asphalt paving, has been developed by the Milwaukee Gas Tool Corporation, Milwaukee, Wis. The machines have been in tests on the job for two years working under the most severe conditions. This machine is known as the Rodax. It is a gasoline hammer which has no flywheel, connecting rods, camshaft or bearing. The piston operates as the hammer, striking more than 1000 blows a minute. These blows are transmitted through an anvil direct to any standard cutting tool which may be used.

The entire unit weighs but 85 pounds and will operate all day on two gallons of gasoline. It requires no outside equipment to operate it and it is a self-contained unit.

The machine will be marketed by the Milwaukee Gas Tool Corporation, Milwaukee, Wisc., through contractors' equipment distributors and manufactured by the LeRoi Co., Milwaukee.

The Rodax, a Self-contained Pavement Breaker

A New Waterproof Building Material

ANYONE who has tried to use ordinary building paper without help, or when the wind was blowing, or has seen his profits cut down by trying to protect work and supplies with expensive waterproofing materials will be interested in Sisalkraft. Sisalkraft is claimed by the manufacturers, The Sisalkraft Co., Chicago, Ill., to have extra strength, to be waterproof, air and dust tight and flexible.

Temporary Structure Built with Sisalkraft in Short Time, Giving Waterproof Protection in Winter

This product consists of two layers of tough kraft coated on the inside with two layers of high quality asphalt, and reinforced with two layers of long sisal fibres running both ways between the kraft layers. All these materials are rolled together under heavy pressure while hot, making a unified product which can be used over and over again. The arrangement of the fibres gives exceptional strength in all directions, permits great flexibility, and promotes easy handling. As there are two layers of asphalt binder between the close-grained kraft, the new material is waterproof to a high degree as well as an effective barrier to dust and air.

Probably the toughness of the new product is the first unusual thing noticed about it. It is tough enough to permit one man to nail an end to the side of a building, unroll the length desired, and then nail the other end without the first end tearing away. No laths for cleats, or tin tops for the nails are necessary. Rough handling does not injure the tough Sisalkraft, and even using it for a wind-break in cold weather by inserting ropes through holes at the corners without reinforcing the holes failed to tear it to pieces.

Water does not appreciably affect this product, and it can be used at a saving to cover supplies which must be kept dry, for temporary protection of all kinds, for shanties and tool houses, and for similar purposes where weather is a factor. Samples of Sisalkraft can be formed into cups which will hold water for months without leaking. Used under floors this new product keeps out moisture, preventing warping of the flooring, and stops coal dust from coming through into rugs.

Since recent researches have shown that air coming through supposedly tight walls causes great loss of heat, Sisalkraft is used to stop the innumerable air leaks which let cold air in and heated air escape through ordinary wells. As it can be pulled up tight and applied without cracks and rips, this material prevents all air seepage. Although Sisalkraft is not an heat insulator it is highly effective when used between the walls to create dead air spaces, and it has also proved an excellent means for preventing the usual large heat losses through unprotected roofs of buildings.

Labor costs can be reduced where Sisalkraft is used because only one man is needed to handle it, and is much easier to apply than building paper. It is not easily punctured, and stepping on it, or the accidental dropping of tools while working with it, causes no damage. Folding, twisting, and bundling do not break the sisal fibres nor the outside surfaces, so that roughed or mussed up lengths can be strightened out and used like new pieces.

There is no odor to Sisalkraft and it is clean and pleasant to handle at all times, as the kraft on both sides keeps the asphalt in and in good condition. A very common use is to lay the Sisalkraft on finished floors to protect them from other finishing work. In one instance in the east, where the new product has undergone extensive tests, it was laid over the rugs in a model home. In fair weather and foul over 10,000 persons tramped over the Sisalkraft without causing slightest damage to either rugs or floors, and the Sisalkraft was left in good condition ready for other uses.

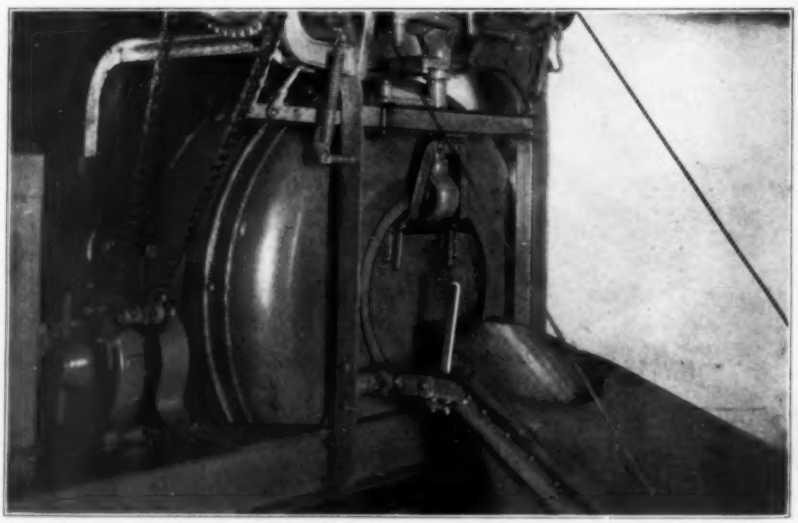
Perhaps the leading factor which has caused extensive use of Sisalkraft so soon after its introduction, has been the low cost for its waterproofing protection. Also considerable savings are possible through the use of Sisalkraft as less labor is required.

Sisalkraft is made in rolls of various widths, 36, 48, and 60 inches. The 36-inch width roll contains either 500 or 900 square feet. The other rolls are furnished in lengths of 300 feet.

New Splash Plate for 7-S and 10-S Mixers

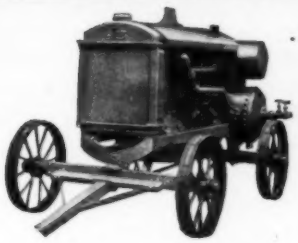
A CHARGING side splash shield for use on non-tilting mixers, has been developed by the Leach Co., Oshkosh, Wis. The purpose of this device, as the name implies, is to prevent splashing materials from leaving the mixing drum during the mixing process. On actual demonstrations in this field, it is reported that the splash shield prevents the disagreeable and annoying occurrence of wet concrete splashing on the men working on the charging side of the mixer.

The Leach splash shield is automatic in its action. That is, during the charging of material into the drum, the shield is pushed away from the opening, allowing a free flow of material into the drum. In addition, it assists in the charging of dry aggregate into the drum by virtue of the fact that it acts as a reflector. The design of the splash shield is such as to permit its installation in any 7-S or 10-S Leach mixer now in the field.



The New Leach Splash Plate for Non-tilting Mixers

Here's Real Performance!



Thor "SIX" Compressor Demolishing Reinforced Concrete Bridge

For cutting concrete as well as costs, the THOR 6 Compressor and Paving Breaker is an unbeatable combination.

The THOR 6 is the only compressor with a Super-Charger, which enables it, by actual test, to deliver 26% more air than any other Compressor of the same size. The Rix Super-Charger is an exclusive, patented and fool-proof feature that utilizes the idle or downward stroke of the piston to compress the additional air the THOR delivers.

Another feature that is attracting unusual attention is the unit-type construction of the THOR. Both engine and compressor are mounted on a common crank-case, eliminating gears, clutches and couplings. The advantages of this "direct-connected" design are tremendous and it is responsible for the low upkeep cost every THOR user experiences.

THOR Paving Breakers match the compressor in performance. They are powerful, exceptionally speedy and rugged. ***THE MOST IMPORTANT FEATURE, HOWEVER, IS THEIR LACK OF VIBRATION.*** Your men will appreciate this distinctive feature by producing more work.

By all means investigate THOR equipment. You have everything to gain and nothing to lose. And the money you will save will be well worth the time spent.

Write for Bulletin 103

DON'T FORGET THE THOR LIGHT PAVING BREAKER, THE FASTEST ON THE MARKET

A FEW DESIRABLE TERRITORIES ARE STILL AVAILABLE. DISTRIBUTORS ARE INVITED TO WRITE FOR DETAILS OF OUR ATTRACTIVE PROPOSITION.

INDEPENDENT PNEUMATIC TOOL CO.

PNEUMATIC TOOLS

GENERAL OFFICES
600 W. Jackson Blvd.
CHICAGO

ELECTRIC TOOLS

FACTORY AURORA, ILL.

BRANCHES THE WORLD OVER

Eastern Office 1463 Broadway, New York

London Office 40 Broadway, Westminster, London

A Heavy Haulage Job Satisfactorily Handled by a Caterpillar Tractor

Old Brick Wall Resists Demolition

THE demolition of the old Manhattan Storage Warehouse, Lexington Avenue, New York, by the Chanin Construction Co., New York, for the erection of a 52-story office building was, in all probability, one of the most costly and difficult wrecking operations undertaken in New York during 1927. The warehouse was so solidly built that more than four months were required to raze the seven stories to the ground level. By the time the excavation was completed and the first steel column set in place, wrecking and digging crews were at work for almost nine months. The crews never consisted of less than 125 men and they have worked in double shifts for most of the time.

The wreckers were not long in discovering that in appearance the old structure did not belie its strength.

"Erected in the 80's when the disorders of the Civil War period were still fresh in the minds of New Yorkers," said Irwin S. Chanin, head of the Chanin interests, in an interview with the *New York Sun*, "the building was something more than a fireproof warehouse. With walls of burnt brick set in portland cement, frequently as much as four feet thick with innumerable interior walls of solid masonry, the Manhattan warehouse was almost a fortress, assault-proof as well as fireproof.

"It is doubtful if shell fire from the East River from the muzzle-loading cannon of the type used in the Civil War would have had much effect upon it. So stubbornly did the old cement cling to the bricks that after a week of ineffectual work, all efforts to clean and salvage the brick were completely abandoned."

The razed building antedated present methods of steel construction. So much material was built into the structure, that Mr. Chanin estimated that more than half a dozen buildings exactly like it could have been erected by the use of present methods of construction.

The sturdy old building belonged to the pre-steel era, but contained about 3500 metal beams which offered the most stubborn resistance to the wreckers. They were attacked in the modern method by being burned out with acetylene torches instead of by tearing away the masonry at the beam ends.

The strength of the building was shown further when the upper floors were being razed. They naturally were the lightest but they came down only at the rate of a floor in two weeks.

Wrecking operations began on April 23, 1927. It was Labor Day before the pile had been reduced to sidewalk level and even then the walls adjoining the existing buildings of the Bowery Savings Bank on the left had not been touched.

To avoid blasting, the walls were drilled down by a dozen men working in two shifts during two months. Instead of removing the brick in its solid form, they broke it up, practically pulverizing it.

Rock excavation for the new building began the day after Labor Day, 125 men digging in double shifts with the aid of three hoisting derricks, three steam shovels and three air compressors. The extreme depth of the excavation is about 55 feet.

Estimates of the Chanin engineers show that the clearing of the site necessitated the removal of more than 7500 truck loads of brick, about 1000 truck loads of scrap metal, and miscellaneous material, about 3500 cubic yards of loose earth and rubbish and about 15,000 cubic yards of newly quarried rock. Estimating a truck load of earth or rock at 5 cubic yards, the services of approximately 18,500 trucks, each making one trip, would have been required for the removal job.

It is of interest that the materials from the warehouse's solid underpinning largely are being taken to upper Manhattan for use at the pierheads of the new Hudson River Bridge.

Accident prevention in the construction industry is a matter of human relations rather than an engineering problem, except as to mechanical safeguards, which are preventative of a surprisingly small percentage of accidents

What a Contractor Thinks About—When He Eats

Specifications for

SECOND ANNUAL BANQUET

Staff and Organization

FRANK W. GOBLE

Prepared by

IMA MacTRUCK, *Architectural Chef.*

DINNER—7:00 P. M.

Workmen to be on the job at 6:30 P. M.

Operations begin promptly at 7:00 P. M.

GENERAL CONDITIONS

Operations must be conducted in a workmanlike and orderly manner, such abuses as the whisker straining or gargling of soup, crunching olive pits or scattering biscuits will not be tolerated. Site to be kept broom clean and work forwarded without interruption.

All consumption strictly at user's risk.

Accidents must be promptly reported for First Aid treatment.

Dinner Pail

COCKTAIL: Of California fruit, variegated in color, selected for flavor and lusciousness, cubed and served with natural juices in crystal containers.

CELERY: Slightly translucent, channel shaped, bleached, and tensile strength of not less than two pounds. Must not contain an excess of fibre.

OLIVES: Thoroughly soaked in brine. Oil content shall not be excessive. To match Shaw-Walker filing cabinet in color, center to be very dense.

DINNER ROLLS AND BUTTER: Wheat to have been husked and pulverized, mixed with approved ingredients in a sanitary manner and left to dry kiln for twenty minutes. In using, break into handy sizes, spread with the golden yellow lubricant provided by owner, to be made from Grade "A" lacteal fluid extracted from kine.

OX TAIL SOUP: Washed and to be reasonably free from vegetable matter. Must be properly disjointed and removed from bovine before mixing. This dish must be bully.

ROAST LEG OF LAMB AND CURRANT JELLY: To be carefully selected as to age, no substitute accepted, fibre and texture satisfactory to the user and of ample proportion.

Relish to be a semisolid glutinous substance made from round acid berries. Flexible enough to quiver when shaken, but not to flow. Sugared properly.

GREEN PEAS: To be a shade between olive and Irish green, and to pass a mesh of 7-16 of an inch. To be imperceptibly flattened but enough to retard their rolling off a knife.

CARROTS: To be a bright vermillion color, properly tapered and scraped, diced and mixed with the above aggregate in the proportion of 1 to 1.

POTATOES au GRATIN: White Aroostook Potatoes properly graded to size. Aggregate to be mixed one and one half minutes, covered with granulated and suitably cured, pressed curd of cream.

CANDIED YAMS: To be triangular in shape, soft to the touch, lightly glazed with a translucent glucose substance and of satisfactory flavor.

GINGER ALE: Color to match "the taste of the morning after," specific gravity to be between 1.02 and 1.09, infused with pungent, spicy rootstock and effervescent with sparkling bubbles. Of ample strength, but great care must be taken that too much strength is not present.

GREEN APPLE PIE a la Mode: No less than two inches in thickness. Free from seeds and other defects. Outer shell to be properly kiln dried, the whole covered with a properly proportioned delectable mixture, temperature of which is to be maintained below freezing until used.

COFFEE: African Brown, and of slight viscosity, of choice Brazilian stock previously toasted and crushed.

CIGARS: If used in this work, they shall be Zeppelin type, not more than six inches in length, nor three-fourths of an inch in diameter. Closed end to be punctured before using. If gaseous content is too pungent this material will be rejected. If of the two for a quarter variety, they must be the 20 center not the nickel one.

CIGARETTES: To be of vegetable and not of animal origin, conveniently stacked so user will not be required to walk a mile for this material. Shredded tobacco neatly encased in rice paper cylindrical shaped 3-½ inches in length. Not necessarily toasted, they must satisfy and show a whale of a difference in coughs.

Courtesy of Frank W. Goble, White Plains, N. Y.

Ransome Two Important Factors *in the* Design *of* Concrete Chuting Equipment

1. SLOPE A leading authority* states: "It is recommended that the combination of these factors shall allow a slope not flatter than 1 *to* 3 *nor steeper than* 1 *to* 2."

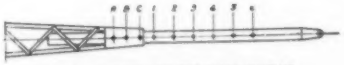
Ransome Bulletin No. 203, *published in* 1926, page 35, shows a diagram of a telescopic boom setting for slopes *of* 1 *to* 3 and 1 *to* 2 and intermediate slopes as required. (Illustrated below.)

2. END CONNECTIONS A leading authority* states: "The *increased size of end connections* and their improved shape have done much to eliminate overflowing and clogging."

Ransome Bulletin No. 201, published in *March* 1919 states: "Ransome Hopper Heads have been increased 25% in depth." A second increase in size was made in 1922. In 1926 the size was increased to 32 in. in diameter and average depth of 25 in. for the 12 in. chutes. For the 18 in. chutes the diameter was increased to 48 in., the depth to 33 in.

** Name upon request*

The large circular Ransome Hopper Head does not check the rate of flow of cement.



BOOM SETTINGS FOR DIFFERENT SLOPES OF CHUTES

SLOPE OF CHUTES	USE HOLES
1 ON 3 FOR 40 FT. BIN	B-1
1 ON 3 FOR 60 FT. BIN	C-2
1 ON 2 FOR 40 FT. BIN	B-4
1 ON 2 FOR 60 FT. BIN	A-3
INTERMEDIATE SLOPES AS REQUIRED	

Note that the Boom Setting of Ransome equipment provides for slopes of 1 to 3 and 1 to 2 and intermediate slopes.

RANSOME DOMESTIC REPRESENTATIVES

ALBANY, N. Y.
Super-Speed Supply Co., Inc.
ASHEVILLE, N. C.
North State Culvert & Machinery Co.
ASTATULA, FLA.
Prescott Machinery Co.
ATLANTA, GA.
Henry G. Williams
R. F. Avery
BALTIMORE, MD.
Giles & Ransome
BIRMINGHAM, ALA.
South-Meadow Supply Co.
BOSTON, MASS.
The Clark-Wilcox Co.
BROOKLYN, N. Y.
Fitzgerald & Sheehan
BUFFALO, N. Y.
The Wheeler-Murray Co.
BUTTE, MONTANA
Western Supply Co.
CANTON, OHIO
J. C. Neely & Co.
CLARKSBURG, W. VA.
Clarksburg Supply & Equipment Co.
CHARLOTTE, N. C.
W. Ford Casey and Co.
CHATTANOOGA, TENN.
Brown Craven Equipment Co.
CHICAGO, ILL.
Ransome Concrete Machinery Co.
CINCINNATI, OHIO
The C. Taylor Handman Co.
CLEVELAND, OHIO
C. F. Pegg Co.
COLUMBIA, S. C.
Construction Equipment Co.
DALLAS, TEXAS
J. W. Barthelow Co.
DAVENPORT, IOWA
The Johnson-Beckwith Equipment Co.
DENVER, COLO.
Clinton & Held Co.
DETROIT, MICH.
W. H. Anderson Tool & Supply Co.
FORT WORTH, TEXAS
J. W. Barthelow Co.
GRAND RAPIDS, MICH.
W. H. Anderson Tool & Supply Co.
HUNTINGTON, W. VA.
Banks-Miller Supply Co.
LOS ANGELES, CAL.
Ensek & Co.
MEMPHIS, TENN.
Pidgeon-Thomas Iron Co.
MINNEAPOLIS, MINN.
Wm. H. Hale & Co.
MOBILE, ALA.
Lawrence-Gwilling Co., Inc.
MONTREAL, CANADA
Canadian Equipment Co.
NASHVILLE, TENN.
R. L. Stoddard
NEWARK, N. J.
Johnson & Dickerson, Inc.
NEW HAVEN, CONN.
The Clark-Wilcox Co.
NEW ORLEANS, LA.
Otto K. Olsen
NEW YORK CITY
Fitzgerald & Hudson
NORTHPORT, N. Y.
F. G. MacDonald
OAKLAND, CAL.
R. T. McClelland
OKLAHOMA CITY, OKLA.
R. W. Ragsdale
PHILADELPHIA, PA.
Giles & Ransome
PITTSBURGH, PA.
Raume Machinery Co.
PORTLAND, OREGON
McCracken-Ripley Co.
RICHMOND, VA.
Ed. P. Phillips Machinery Co.
ROCKFORD, ILL.
Swords Bros. Co.
SAN ANTONIO, TEX.
Brandt Iron Works
SEATTLE, WASH.
Star Machinery Co.
SPOKANE, WASH.
Hallidie Co.
ST. LOUIS, MO.
Lincoln Equipment & Materials Co.
SYRACUSE, N. Y.
The Wheeler-Murray Co.
TOLEDO, OHIO
National Supply Co.
TORONTO, ONTARIO
Clare Osborn, Ltd.
VANCOUVER, B. C.
B. C. Equipment Co.

WRITE FOR BULLETIN NO. 203

Ransome Concrete Machinery Company

1850—Service for 78 Years—1928

Dunellen **New Jersey**

A Gasoline-Electric Shovel for Heavy Work

IN the revamping of the passenger station facilities of the Pennsylvania Railroad in Philadelphia, Pa., a project that is estimated to cost approximately $100,000,000 and that will take about ten years to complete, a Marion Type-7 gasoline-electric shovel is being used in the preliminary work of clearing up buildings and opening streets.

The contract for part of the preliminary clearing-up work was awarded the Keystone State Corporation of Philadelphia. On account of needing small clearances and extreme mobility, it was desired to use a gas-driven excavator on this work. The machine had to be able to handle successfully some very hard digging and large pieces of concrete and brick, which heretofore had been considered a duty too heavy for a gas-driven machine. The gasoline-electric shovel combines the independence of gasoline as a fuel with the flexibility of the steam machine to meet the service required in this project.

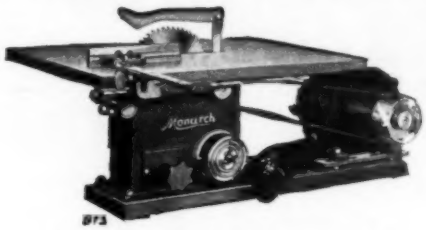
The Marion Type-7 Gasoline-Electric Shovel Used on the Pennsylvania Railroad Station Job

In this type of shovel, the gasoline engine is directly connected to an electric generator which supplies power to drive the shovel. There is no mechanical connection between the engine and any motion and there is a separate motor for the hoist, one for the swing and one for the crowd. Each motor is connected through gears to the motion which it is to drive, thereby following through the principle employed so successfully on the steam machine where a separate-geared engine is used to drive each motion. These motors give high speeds at light loads and low speeds at heavy loads, thereby obtaining speed and pull as required and reducing the mechanical shocks on the machine. With the gasoline-electric shovel, there are no clutches of any kind between the engine and the hoisting machinery and with it, it is possible to hook under a load and obtain maximum pull without stalling the engine or subjecting the machine to excessive shocks. It is possible to get maximum pull on the hoist without excessive shocks and is not possible to stall the gasoline engine by the stalling of any one or all of the motions.

A Ball-Bearing Bench Saw

CONTRACTORS will be interested in the new Monarch product that has been put on the market by the American Saw Mill Machinery Co., Hackettstown, N. J. It is a woodworker's precision machine with solid cast table, 18 x 24 inches, which tilts to any angle up to 45 degrees and is operated by means of a convenient hand wheel at the side of the pedestal.

The table is raised and lowered by means of another hand wheel which is also located at the side of the pedestal. The tilting device operates through a worm gear and quadrant, both having cut teeth. The raising and lowering device operates through bevel gears and screw which provide accurate setting to regulate the depth in grooving and rabbetting work. The table has a rise and fall of 2¼ inches, the saw projecting through the table at its highest point. The saw furnished is a combination rip and cut-off saw, 8 inches in diameter.



The New Monarch Saw Table

The table is provided with a combination rip and cut-off gage. When used as a ripping gage the slide head is locked and the fence is swung around to the 90-degree position and locked. There is adjustment for accurate alignment with the saw. When used as a cut-off gage the slide head is released and the gage moves on the table, being guided by a steel bar to which the slide head is gibbed.

The fence may be set at zero for square work or at any angle desired for mitre work, the quadrant being provided with degree graduations. The ripping gage opens from the saw 9½ inches and a graduated bar indicates the distance from the saw. When the cut-off gage is drawn back to its extreme position the distance from the face of the fence to the edge of the saw is 7 inches.

The mandrel runs in ball bearings. It takes saws with ¾-inch hole and there is sufficient space between the collars to admit grooving or dado heads ⅝-inch thick. The machine proper is attached to a sub-base which also carries the electric motor. The motor is mounted on rails having considerable adjustment for belt length. It is also provided with screw adjustment for belt tension. This machine may be furnished without the sub-base and may be driven from any conveniently located motor or from an underneath countershaft.

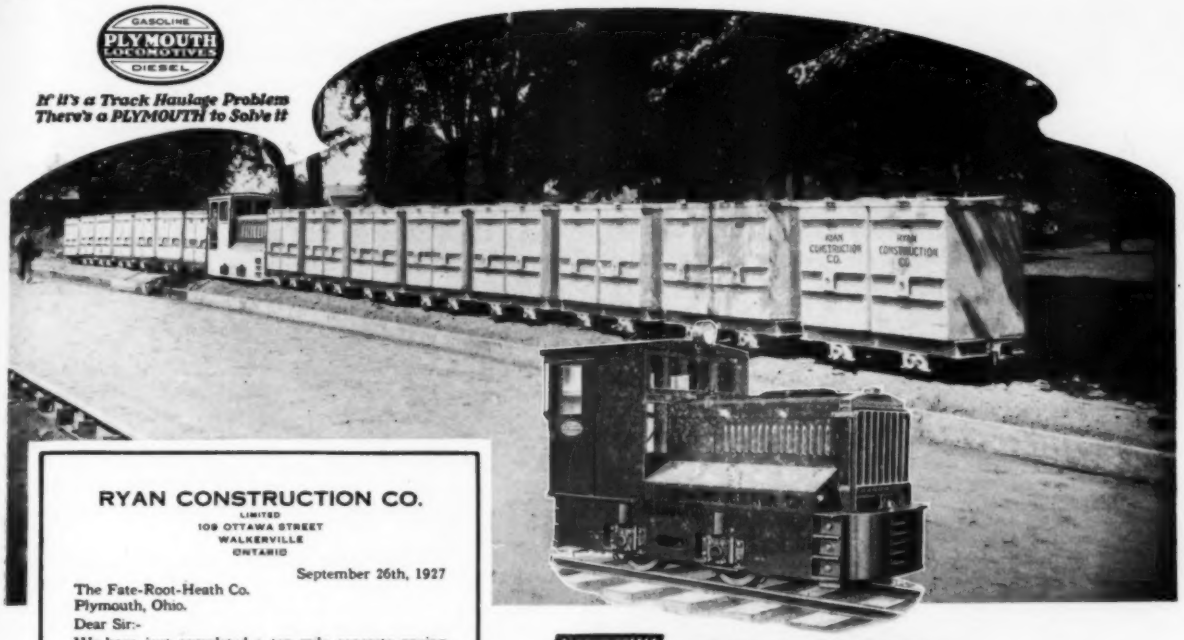
The motor regularly furnished is ½-horsepower, single phase, 110-220 volts for 60-cycle current, to operate from a standard light socket, starting switch, cord and plug being furnished for that purpose. A 3-phase, 220-volt, or 110-volt, 60-cycle motor may be furnished instead.

Interesting Demolition

A Wrecking Job Speeded by a Caterpillar Tractor

GASOLINE PLYMOUTH LOCOMOTIVES DIESEL

If it's a Track Haulage Problem There's a PLYMOUTH to Solve It



RYAN CONSTRUCTION CO.
LIMITED
108 OTTAWA STREET
WALKERVILLE
ONTARIO

September 26th, 1927

The Fate-Root-Heath Co.
Plymouth, Ohio.

Dear Sir:-

We have just completed a ten mile concrete paving job for the Ontario Government on which we used four of your eight ton locomotives.

These locomotives gave us wonderful satisfaction and we are proud to say that at no time was our mixer held up for lack of material. We used forty-eight foot boxes and loaded them to capacity at all times and our trains varied from fifteen to twenty cars, according to the length of our haul. The maximum haul from the batcher plant was 7.1 miles over undulating country.

We thought you might be interested in this information and also so far as we know this is the first highway job in Ontario where the Industrial Railway system has been used.

Yours very truly,
RYAN CONSTRUCTION COMPANY LIMITED

D. H. Woollatt

Vice President.

FOUR PLYMOUTH GASOLINE LOCOMOTIVES

ON FIRST HIGHWAY JOB IN ONTARIO USING INDUSTRIAL RAILWAY HAULAGE —

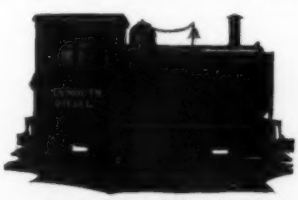
In adopting rail haulage and Plymouth power for the construction of a ten mile concrete paving job for the Ontario Government, the Ryan Construction Company have pioneered the "insurance against wet weather losses" method of delivering materials, in Ontario. This method has gained much favor and assured figured profits for an ever increasing number of contractors in the States during the past five years.

"The chance taker loses" — To gamble on a dry season is risking your estimated profit and even chancing a loss. To be able to say when the job is done — "At no time was our mixer held up for lack of material", means not only satisfaction to all concerned but coming out on the right side of the ledger.

Rail haulage with Plymouth Gasoline Locomotives is truly a "Business interruption insurance" you should never overlook.

PLYMOUTH LOCOMOTIVE WORKS
The Fate-Root-Heath Company
PLYMOUTH, OHIO

PLYMOUTHS *First* ON ONTARIO HIGHWAY CONSTRUCTION



THE PLYMOUTH 10-TON DIESEL LOCOMOTIVE

A full range of sizes--from 10 to 50 tons.

Fuel oil in many territories has proven its economical advantage. Wherever fuel oil is available, Plymouth Diesel Locomotives will effect a saving in fuel cost even greater in proportion than Plymouth Gasoline Locomotives have made over other methods of haulage.

PLYMOUTH
GASOLINE *Locomotives* DIESEL

Paving for Corrugated Culverts

AMONG the many problems with which highway engineers and public officials in charge of drainage work have to contend is that of culvert erosion. Always a factor to consider, it is an especially important one in the case of culverts carrying sedimentary streams and culverts placed with a steep grade. Drainage lines carrying water of a chemical nature also are subject to rapid deterioration. In all of these cases the service life of the installation is often materially curtailed unless some protection against erosion is provided.

This important problem has been the subject of study and research by the Armco Culvert Manufacturers Association, Middletown, Ohio, for a number of years. The solution developed from this study became available late in 1927. It consists of a pipe provided with a specially prepared invert pavement, thus protecting its most vulnerable part against attack and giving the structure practically uniform life throughout. Its distinctive feature is a pronounced floor which not only fortifies the bottom of the pipe against wear, but facilitates flow.

New Armco Paved Culvert

This invert pavement does not take the place of durability of the culvert metal. The Armco paved invert pipe provides a culvert which adds resistance against invert erosion to the rust-resistive qualities of Armco culverts.

A New Heavy-duty, 10-ton Tandem Roller

WITH the increasing demand for more compression on asphalt pavements and also for motor-driven tandem rollers to replace steam tandem rollers, the Galion Iron Works and Manufacturing Co., Galion, Ohio, has developed and announces a 10-ton, heavy-duty tandem motor roller, which has a 3-section steering roll.

This new roller is powered by a Hercules Model-G motor. The power steering is operated by the same motor and a special transmission, designed and produced in the Galion plant, meets the special requirements of tandem service on asphalt. The important considerations in this work are smooth operation and quick, positive reversing. Jerky operation or allowing the roller to stand still more than an instant is bound to result in an uneven asphalt surface. Reversing instantly and smoothly without a gear shift is characteristic of the new Galion roller. Thorough tests on asphalt work under the strictest requirements have shown that this roller meets all requirements, according to the manufacturer.

The New Galion Tandem Roller

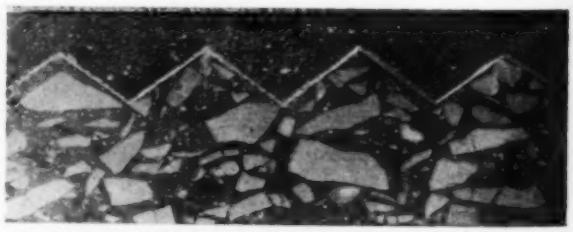
This new piece of equipment supplies the demand for more compression on asphalt pavements and gives a sturdy, dependable unit.

In its new line of motor tandems, in which the 10-ton heavy-duty tandem is the latest, the Galion Iron Works and Manufacturing Co. claims to have attained fully all the advantages of the steam tandem without the disadvantages of supplying fuel, frequent firing and the smoke annoyance. This roller completes the Galion line of motor tandems, which now consist of 10-, 9-, 8-, 7-, 6- and 5-ton sizes. The Galion line also includes steam tandems in the same sizes.

Thoroughly Compacted Black Base Construction

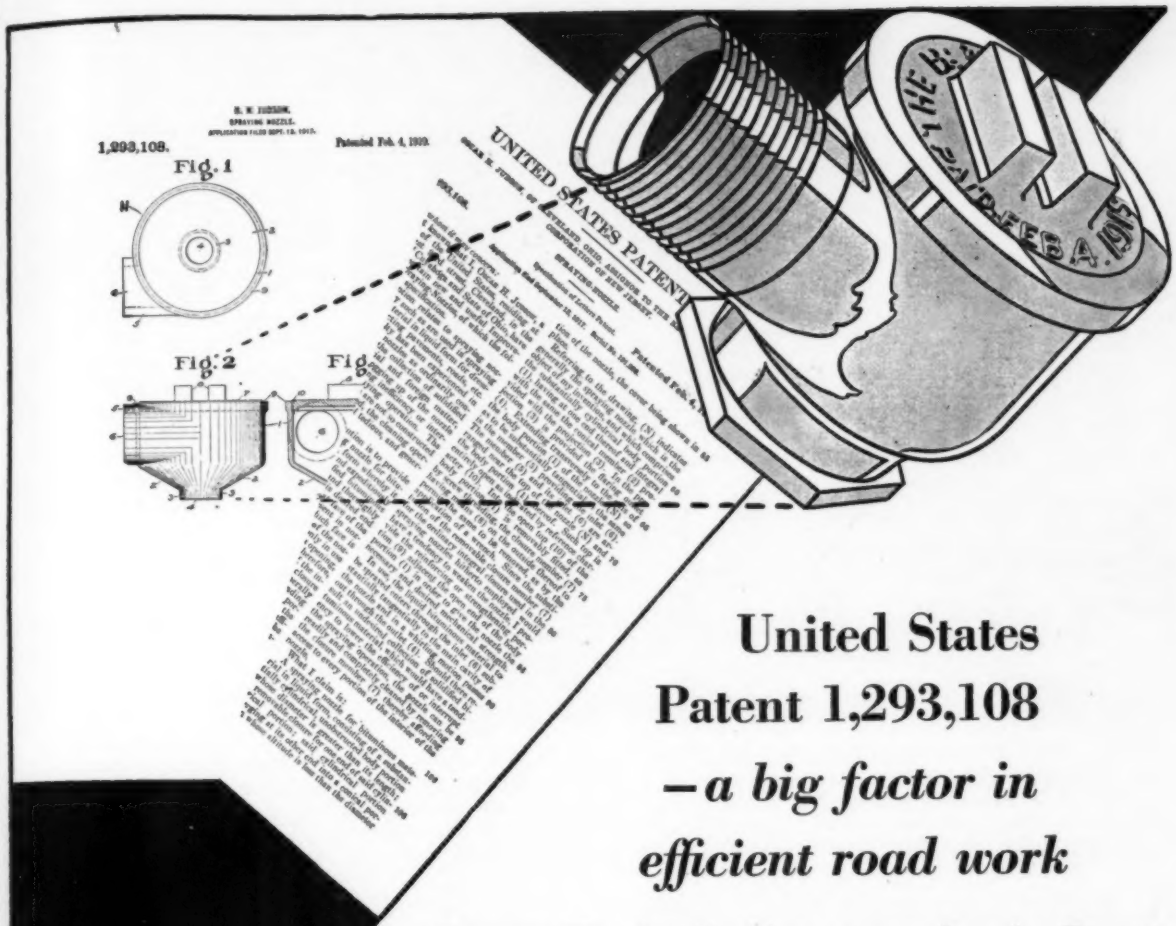
UNDER the trade name "Interlock Asphalt," the Interlock Asphalt Pavement Corporation, 250 West 57th Street, New York, is prepared to supervise the construction of a new type of asphalt pavement which is claimed to have several desirable features.

This new company, which will promote the C. A. Mullen patents in the United States, is headed by A. Reginald von Keller. The patented feature of the pavement consists of a uniform predetermined pattern which is impressed on the base course, allowing the use of a dense, asphaltic contrete type mixture, owing to the fact that the pattern gives the top course a distinct key, instead of relying on the porous surface as in the ordinary pavements, for the bond. This pattern is impressed by a small, narrow, corrugated roller mounted on a bridge which spans the pavement. This roller, plus the tamping air gun mounted on it, produces a sawtooth section as shown in the illustration. Any inequalities in raking are shown up immediately by this roller instead of being "bridged" as with a wide steam roller and the compression is much greater owing to the tamping action of the air gun.



Section of Interlock Asphalt. The Sawtooth Propections of the Base Course, Slightly Outlined, are 1½ Inches Center to Center

The upper course is relatively thin and consists of a thin asphaltic or stone-filled sheet asphalt mixture raked over the under course and rolled in the usual manner.



United States Patent 1,293,108 —*a big factor in efficient road work*

Barrett Tarvia distributors—and only Barrett Tarvia distributors—are equipped with the patented Barrett non-clogging nozzle. This unique nozzle (manufactured under U. S. Patent 1,293,108) assures uniform, unbroken distribution of the Tarvia. No strips or streaks left uncovered to cause "break-ups" later on.

Note: These nozzles are used exclusively on Barrett Tarvia equipment and are not for sale.

Tarvia
For Road Construction Repair and Maintenance

The Barrett Company

New York	Chicago	Philadelphia	Boston
St. Louis	Cleveland	Cincinnati	Kansas City
Detroit	Salt Lake City	Birmingham	Lebanon
Minneapolis	Milwaukee	Bethlehem	Columbus
Youngstown	Syracuse	Toledo	Rochester
Baltimore	Providence		Buffalo

In Canada:
THE BARRETT COMPANY, Limited
Montreal Toronto Winnipeg Vancouver

THE BRABAZON SHOULDER MAINTAINER AT WORK

1. The Distributor Unit Showing Spiral Conveyor. 2. A Shoulder Immediately After Graveling with Maintainer. 3. Method of Driving Spiral Conveyor. 4. The Conveyor in Action, Showing Flow of Material from the Conveyor and Method of Spreading on Shoulder. 5. The Shoulder Maintainer Showing Control Wheel, Delivery Chute and Drag

A Labor-saving Shoulder Maintenance Unit

A FINE strip of portland cement pavement or of asphaltic concrete pavement is all very well for traffic, but vehicles are bound to be forced to the edge and onto the shoulder from time to time. If the shoulder is not maintained in good condition, great damage to both motor vehicles and pavement edge is bound to result. The Brabazon Manufacturing Co., Stoughton, Wis., has developed a shoulder maintenance machine which should be of great interest to state and county highway officials and to contractors. This machine is easily attached to 80 per cent of the present motor dump trucks in use, preferably to dump trucks of from 2½- to 5-yards capacities and when attached forms a rigid unit.

The Brabazon shoulder maintenance machine is attached at the rear of the dump truck, being mounted across the rear of the frame by an 8-inch mounting channel, by three heavy U-bolts clamped over the frame. No holes are drilled into the truck frame for mounting and the machine can be easily detached in fifteen minutes, leaving the truck free for other use, thereby not tying up the equipment.

The machine is power-driven from the left rear wheel by a cast steel sprocket wheel, especially designed for this purpose. The inner footing of the sprocket bolts to the truck wheel and power is transmitted through a heavy-duty pin and cotter type drive chain to a driven-sprocket gear which drives the conveyor through a special clutch.

The 16-inch double spiral steel screw conveyor which is contained in a steel conveyor body carries the materials which flow from the truck and discharges them into a distributor chute on the right side of the truck. When this chute is properly adjusted, it spreads the material to the desired width to fill the shoulder. Coupled to a draw bar on the rear of the machine is a leveling blade weighing 71 pounds. This partially projects over the shoulder and levels all material even with the roadway. Since it is at a slight angle, it brings in the material to the roadway, so that there is no space between the shoulder and the roadway proper. Surplus material is carried to the outer point.

The supply of materials is under the control of the operator at all times, and he is able to furnish more or less material as is required by the fill on the shoulder, as the operator is so located that he has a full view of the shoulder ahead and can make adjustments in ample time. A large hand wheel close to the operator governs the flow of material under the tail gate into the conveyor body and to the conveyor crew.

The distributor chute has a 6-way movement and adjusts itself to any unevenness in the shoulder, and also weaves in and out along the edge of the road to take care of any variation in the path of the truck, by means of a tracer blade which is bolted on the inside of the chute and a tension spring that brings the chute back to its inner position.

As the truck with the maintainer operates at all times on the right-hand side of the roadway, it does not interfere with traffic. The extreme width of the machine is protected by placing flag sockets on each side to carry the highway safety flags as required by some states.

The operator's step is 29 inches wide and 38 inches long, giving ample room for free movement without danger of slipping off.

Indiana State Highway Commission Has Big Year

THE Indiana State Highway Commission, during the fiscal year 1927 ending September 30, paved and resurfaced 398 miles of state roads, thereby placing them in the dustless class, according to John D. Williams, Director of the Commission. Of this mileage, 218 miles were concrete, 72 miles bituminous macadam or rock asphalt, and 108 miles retread. Retread is not pavement, but merely treatment serving as a binder and preventing dust. As a comparison, during the fiscal year of 1926, the Commission paved 223 miles of road, of which 190 miles were cement concrete and the remainder of bituminous types.

Included in the 1927 paving were 70 miles of road contracted for in 1926, but prevented from completion by seventy days of rainfall during the height of the building season. In addition, the Commission during the fiscal year just closed, completed 18 of the 26 miles of heavy grading contracted.

In addition to this road work, the Commission, through the Bridge Department, completed 99 large contracts, all of which were 20-foot spans. This Department awarded contracts totalling $1,250,000 and made contract payments on completed projects amounting to $1,300,000, exclusive of subways.

The total cost of personal and property damage accidents to the construction industry in the United States is over $250,000,000 *per year*

Waukesha Again Leads the Field

Among Heavy-Duty Engine Builders

At the Road Show at Cleveland this year, the exhibitors showing one or more power-driven machines with engines of the same or larger size, including Diesels, totaled more than 100. Nearly 30% were Waukesha equipped.

Names of Engine Builders who exhibited	*Percent of Exhibitors using engines of equivalent type or larger*
Waukesha	**28.6** ←
B	
C	
D	
E	
F	
G	
H	
I	
J	
K	
L	

Sold on Performance

Backed by Reputation

N-814-L

INDUSTRIAL EQUIPMENT DIVISION

WAUKESHA MOTOR COMPANY

Waukesha **Wisconsin**

New York	Kansas City	Denver	Tulsa	Houston	San Francisco
8 W. 40th Street	*V. L. Phillips Co.*	*Wilson Machy. Co.*	*C. F. Camp Co.*	*Portable Rotary Rig Co.*	*C. A. Watts*

Exclusive Builders of Heavy-Duty Gasoline Engines for Over Twenty Years

Novel Method of Raising I-Beams

A FINE opportunity for testing stackers, or portable elevators, in a new line of work, was afforded the manufacturers, the Lewis-Shepard Co., Watertown Station, Boston, Mass., during the construction of the structural work on their new factory addition recently. I-beams were raised to position by two hand power machines of different heights and the operation was entirely successful, according to the contractor. Two men did the work, and each beam was in place in a very few moments, none of the usual crane equipment being necessary.

The average weight of the I-beams was 2,100 pounds and they

I-Beams Being Raised to Position by Lewis-Shepard Stackers at That Company's New Plant Addition

measured 31 feet 8 inches in length. Each of the stackers used was of 750-pounds capacity, so that the overload of 600 pounds, while not amounting to a great deal when divided between the two machines, still is to be considered. No strain was noticed on the stackers while they were being used in this way and the fact that they were of different heights made no difference. They were taken from the plant's own departments and put on the job.

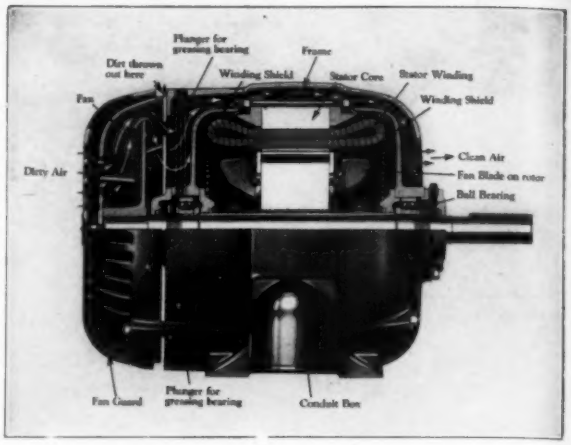
According to the manufacturers, stackers made especially for this type of work would be uniform in size and even more convenient to use. Convenience was the point that impressed them most, for the raising of the beams was accomplished simply by turning the handles of the stackers.

New Types of Electric Motors Developed

CONSTANT tests and investigations in the electric motor field have resulted in the development of new types and modifications of old types to suit the increasing demands of power requirements in the contracting and building field. These new developments have been concerned mainly with the problem of adapting motors for specific applications and to reduce the necessity for frequent inspection.

In order to protect motor windings from dust and dirt, an enclosed type of motor has been frequently used but since the totally enclosed motor has no means of ventilation it must be made considerably larger than a standard motor of the same horsepower output, resulting in high first cost per horsepower, poor power factor and poor efficiency. Moreover, in enclosed motors, the use of air piping for conducting clean air to the motor with a fan built into the rotor of the motor for providing the necessary flow of air had its disadvantage due to the necessity for providing the air pipes, since the installation expense is high and it is frequently difficult to reach a source of clean air without an elaborate system of air ducts.

Overcoming these obstacles, the enclosed self-ventilated type



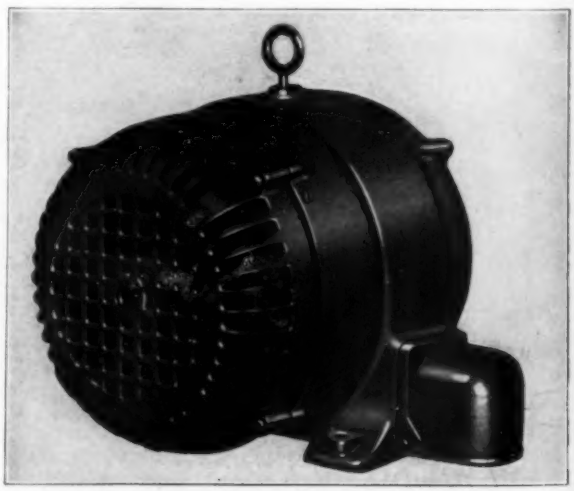
Section of Totally-enclosed Ball-bearing Motor

of electric motor, in which the windings are entirely protected from the air currents, has been produced. A line of such motors with a special air cleaner feature has been announced recently by Fairbanks, Morse and Co., Chicago, Ill.

This motor has a standard stator core and windings and a standard rotor mounted in a supporting shell with an annular air passage between the outside surface of the stator core and the shell. Winding shields are provided so that the stator windings are totally enclosed, thereby preventing any dirt from gaining access to these windings. Cooling air is drawn through an inlet opening at the free end of the motor by means of a special type fan which also functions as an air cleaner. The clean air is blown across the winding shield at the free end of the motor, through the annular air space, then across the outer end of the stator core laminations, thence across the winding shield at the pulley end and out through the openings in the pulley end bearing arm.

The fan is of the closed impeller type and is so constructed that foreign particles are thrown out by centrifugal force, between the edge of the outer shroud and the supporting frame. A perforated guard is placed around this fan cleaner and is carried by the supporting frame. The whole purpose of this guard is to prevent accidental contact with the fan.

Provision is made for lubricating the ball bearings without removing the guard, fan or bearing arms. This is accomplished by the use of a plunger device located in a grease tube ex-



Self-ventilated Motor With Air Cleaning Feature

REMEMBER—Way back when

Grading was done with a couple of planks, 4 mules, 1 horse and a world of patience?

1866

Then we got good!

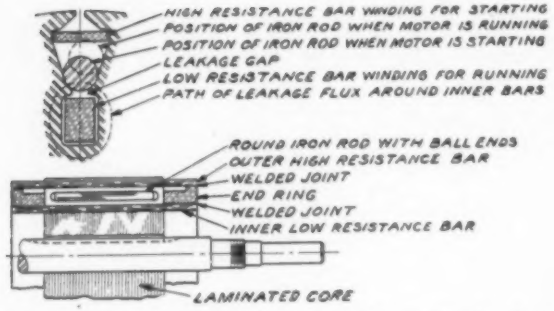
Under an ordinary farm wagon we hooked a blade — 2 husky boys bore down on it by means of levers attached to the platform. The bigger the men — the better the grader.

1879

NOW

Telescopic Axles **Leaning Wheels**
Arched Steel Frames
(HOT RIVETED)
Compensating Springs
Ease for the Operator

Alemite Lubrication
Back Sloper
That's the 1928 Grader!

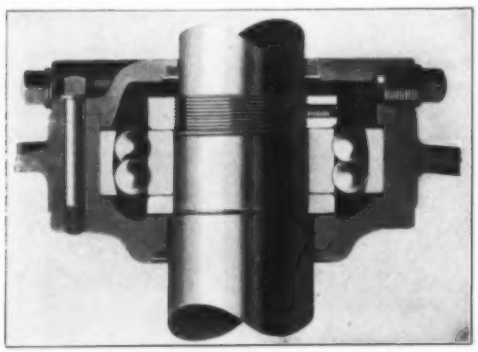

HIGH RESISTANCE BAR WINDING FOR STARTING
POSITION OF IRON ROD WHEN MOTOR IS RUNNING
POSITION OF IRON ROD WHEN MOTOR IS STARTING
LEAKAGE GAP
LOW RESISTANCE BAR WINDING FOR RUNNING
PATH OF LEAKAGE FLUX AROUND INNER BARS
ROUND IRON ROD WITH BALL ENDS
OUTER HIGH RESISTANCE BAR
WELDED JOINT
END RING
WELDED JOINT
INNER LOW RESISTANCE BAR
LAMINATED CORE

Improvement in Double Squirrel Cage Motor Showing Loose Iron Rods

tending through an opening in the bearing arm into the bearing housing.

The one main disadvantage of the squirrel cage motor, however, has been due to its high starting current. In small motors, the higher starting current is not objectionable for most power companies will permit the installation of motors up to 5 horsepower without requiring the use of a voltage reducing starter. With larger motors, it is necessary to use some type of starter which will reduce the voltage and thus limit the current during the starting period. On types of service requiring a high starting torque such as those having considerable inertia or static friction, starters of the reduced voltage type impair the ability of the motor to start the load.

This disadvantage has occasioned the development of the



The Application of Ball Bearings to Electric Motors Has Shown Great Progress

double squirrel cage type of motor, in which two sets of bars are placed in the rotor, each set being connected with its own end rings. The low resistance bars in this case are placed in comparatively deep slots in the rotor and the higher resistance bars in comparatively shallow slots. The inner low resistance winding in the iron rotor core chokes the current in this winding at the starting and forces it to flow in the outer high resistance winding, thereby producing high starting torque with comparatively low starting current. After the motor has accelerated and is carrying a normal load, the low resistance winding carries the greater portion of the current but because of its position in the rotor core the power factor and maximum torque are less than with a standard or single squirrel cage winding. The low efficiency increases the power cost of operating the motor and the low power factor is objectionable to the power company.

A variable leakage double squirrel cage type of motor, which largely overcomes these objections, has been developed recently by Fairbanks, Morse and Co. In this motor, the current in the inner winding at starting is choked by means of movable iron rods, placed in each rotor slot between the inner and outer bars. The instant the motor is connected to the line the iron rods are pulled down towards the inner bars, closing the small leakage gap in the rotor iron which almost completely chokes the current in the inner low resistance winding by forming a complete iron circuit around each inner bar. This choking action on the inner winding forces practically all of the current to flow in the outer high resistance winding at starting, thus producing a high starting torque with a low starting current.

As the rotor accelerates, the iron rods are thrown out of the leakage gaps by centrifugal force which removes the choking effects from the inner winding when the motor is running. This results in a much better running performance than is possible with the older style of double squirrel cage motor. It is also possible to use much higher resistance in the outer winding where exceptionally low starting current is desired and where the starting torque requirements are moderate.

Other important refinements in electric motors are ball bearings and grease lubrication. There is no appreciable wear on ball bearings and high mechanical efficiency is obtained.

Sodium Silicate a Concrete Road Hardener

THERE are three ways in which silicates may be used for road building. First, it is a good hardener for portland cement concrete. The resistance of any concrete surface to abrasion can be substantially increased by treatment with the proper dilute silicate after the concrete has set. The same process reduces the penetration of water into the concrete and thereby the risk of deterioration due to the destructive influences of frost. This use applies to factory floors and to road surfaces.

Second, silicate solutions provide a useful treatment for freshly laid concrete to protect it during the curing process. A film of silicate spread over the surface of the newly laid road produces, by local reaction with the cement, a skin which is not easily affected by water. It further helps to retain the needed water into the mass until it has been chemically bound in the crystalline compounds on which the ultimate strength of the cement depends. This has been specially developed in connection with vibrolithic methods of consolidating a road. The procedure consists of sealing the surface with a silicate of low alkalinity such as the "N" brand made by the Philadelphia Quartz Co., Philadelphia, Pa. This is diluted to 30 degrees Baume by mixing three measures of "N" with one of water. This makes it thin enough to work easily with a brush, squeegee or sprinkling can and still gives an adequate coating. The most critical time for the strength of a road is within the first day after it is laid. Therefore the silicate should be put on as soon as practicable which is when the concrete is just hard enough to bear the weight of a man and show no mark. Sometime between 6 and 24 hours after the cement is poured is the best, though there is an advantage in silicating concrete at any age after the first set. The cost is very low. Silicate added to the water in which the concrete is mixed hastens the set and if much is used reduces the final strength. It is inadvisable except in a few special cases.

The third type of use in connection with roads consists of mixing finely divided stone directly with the silicate solution, spreading it on the road surface and covering the plastic silicate mortar with a layer of larger pieces of stone. These are firmly set in a strong matrix under the action of a heavy roller. If limestone dust is used and the road can be dried before it rains, a very strong mass is formed which gradually becomes insoluble under the influence of the atmosphere and which under the most favorable conditions makes a very hard surface. In the last few years many roads of this type have been laid in France, Switzerland, Italy and England.

If the silicate road could be thoroughly dried and then coated with a bituminous carpet or otherwise completely protected from moisture, the result would be very serviceable, but when this is done the cost compared with the cost of the concrete alone tempts the engineer to install an all-concrete roadway and in most localities it is difficult to have assurance of proper drying and setting. The mechanism of making silica

TRIDENT METERS

are durable. Corrosion, that eats the heart out of so many meters, finds no weak spot in Trident metallic working parts. For bronze is used there—bronze, the metal that has outlasted the ages. For simplicity—for finely balanced sensitivity—and for accuracy sustained over long periods of time under all conditions of operation, the Water Works field has learned to depend upon Neptune-built meters. The eight outstanding pioneering developments in water meter design were all TRIDENT. Write for Catalog giving full details.

Over 4,500,000 Trident and Lambert Meters Made and Sold the World Over

NEPTUNE METER COMPANY
THOMSON METER CORP.
50 East 42nd St., New York City
Factory: Long Island City, N. Y.

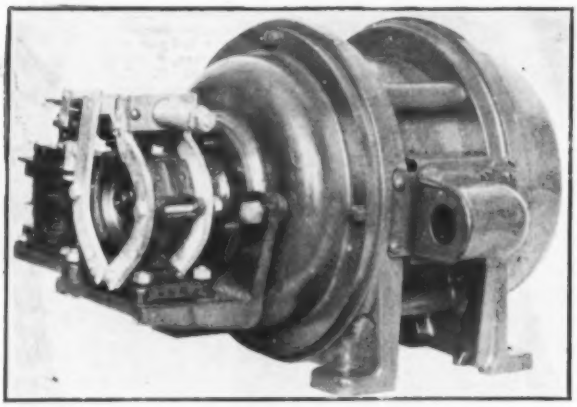
"The Cash Registers of the Water Works Field"

Bronze statuette of an Athlete, a competitor in the Olympic Games, about 600 B. C. Metropolitan Museum of Art

bound macadam with soft limestone appears to include a penetration of the alkali of the silicate into the soft stone forming a binder much more silicious than the original solution. This assists the action of the atmosphere in making the silicate resistant to water, but the final road is to be thought of in the class with macadam, rather than concrete highway. It takes about six gallons of silicate to a cubic yard of limestone dust to make a strong mortar and a 4-inch roadway, including the large stone, can be made at the rate of about 9 to 10 square yards per hundred pounds of silicate.

Totally Enclosed Motors for Portable Hoists

FOR portable electric hoists and other applications involving intermittent operation and high starting torque, the General Electric Co., Schenectady, N. Y., has brought out a new line of motors. This line runs from 1 to 10 horsepower in the direct-current types; from 1 to 11 horsepower, single speed, 3 and 2 phase and from 1 to 5 horsepower, single phase, in the alternating current types. Slip-ring type hoist motors, 3 and 2 phase, are also included from 3 horsepower up.



A Typical 3-Phase Alternating Current Squirrel Hoist Motor with Brake

These new motors are totally enclosed and all parts are well protected. The bearings are of the waste-packed, sleeve type, being closed against the entrance of dirt from the outside. The direct current motors are series wound. The alternating current motors of the polyphase type have high-resistance rotors, while the single-phase motors have a high starting torque.

A brake is required in a great many of the applications of these new motors. Accordingly, the motors are all built with the shaft extension away from the drive to take a brake, and the motor end-shield at this end is fitted with pads or bosses with drilled and tapped holes for mounting the brake.

A New Electric Car Puller

FOR the loading and unloading of railroad cars in contractors' yards it is necessary to have an inexpensive practical means of moving and spotting the cars. To fill such a need, a new and powerful car puller has been developed and placed on the market by the Galion Iron Works and Manufacturing Co., Galion, Ohio.

This new car puller can be supplied with a 5, 7½ or 10-horsepower electric motor as desired. The gear reduction is by means of cut steel gears working in a bath of oil in a dust-proof cast iron housing of heavy ribbed construction. The capstan is vertical as this type permits pulling from any direction. Due to the cut-steel gearing operating in oil, long life and quiet operation are assured.

The New Galion Electric Car Puller

The Galion Car Puller in Use

The second illustration shows the Galion car puller in operation at the yard of the George C. Wolff Coal Co., Chicago, Ill. The shelter shed for the rope, while not essential, is very convenient and desirable, as rope exposed to the weather deteriorates much faster than if protected. The shed also makes it easy for the operator to store the rope and safeguard it against theft.

The car puller itself needs no protection, as all working parts of the car puller proper are enclosed and a weatherproof sheet metal housing protects the motor.

An Improved Tape Hook

A NEW and improved hook for use with steel tapes has been announced by the Lufkin Rule Co., Saginaw, Mich., manufacturers of different types of measuring tapes and rules. This new hook makes it possible for one man to accurately take long or short measurements unassisted and is really indispensable when its low price is considered.

The tape hook is easily clipped on and off the tape and yet it cannot fall off. Zero of the tape falls at the inside of the hook and the hook has a toothed edge, thus taking a firm and square grip on metal or any other material the instant tension is applied to the line, and releases itself when the tension is released. It swings with the ring of the tape, thus guarding against breakage of the line and allowing the hook to fold against the case when the line is wound in. The hook is of composition metal, sturdy, yet of light weight and is convenient to carry anywhere, as it is only two inches long. It is suitable for standard steel tape, ⅜-inch wide, and bears the designation number 252.

The New Lufkin Tape Hook

The only 100% cast iron pipe is Universal Pipe . . .

Tight joints that *stay* Tight!

UNIVERSAL CAST IRON PIPE

No bell holes to dig: No joints to calk

THE CENTRAL FOUNDRY COMPANY

Subsidiary of The Universal Pipe and Radiator Company

Graybar Building, 420 Lexington Avenue

Chicago Birmingham New York Dallas San Francisco

ALL jointing materials unnecessary. No bell holes to dig. No lead to pour. No lead substitutes. Nothing to deteriorate—nothing to work loose in these *flexible* machine-tapered iron-to-iron joints—*joints as tight as the wall of the pipe itself.*

Laid anywhere in any season. Straight lengths laid on curves. Wrenches the only tools.

Thousands of miles installed every year for water supply, fire protection and sewage disposal. Put your problems up to our nearest office.

A Permanent Tail Light or Barrier Light

THERE is nothing much more useless than a tail light that is not lighted. State laws require some kind of illumination on the rear of trucks as a protection to the truck and to other users of the highway. During those trying driving hours of twilight when the contractors' trucks covered with dust and dirt blend into the landscape and when they are on the road after dark, rear end illumination is absolutely necessary for safety. All states require some type of illumination for the rear of motor-drawn or horse-drawn vehicles.

The Persons vehicle reflector, made by the Persons-Majestic Manufacturing Co., Worcester, Mass., has been accepted by many states and by the Department of Public Highways of Ontario as a satisfactory tail light in lieu of lighted lamps. This reflector which throws back the beam of the headlights of an approaching car, is made in either red or green with a

The Persons Vehicle Reflector

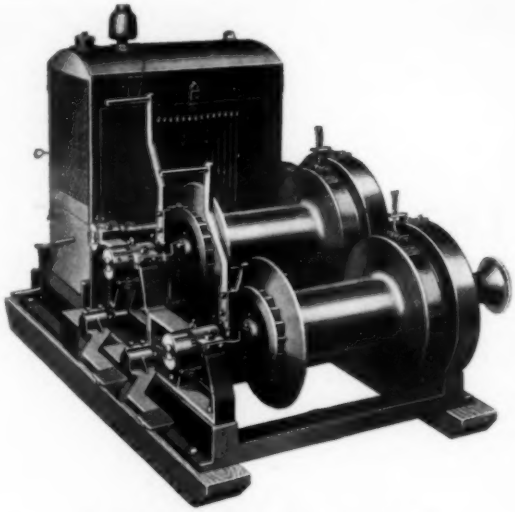
total diameter of 6⅜ inches and with a reflector face 5 inches in diameter. Once in place it is a permanent installation. There is no more worry over broken electrical connections to the tail light, lanterns running out of oil, or the gas in the acetylene tank giving out. It is a genuine protection which prevents damage to contractors' property or the property of others, which guards the contractor's investment in his business and prevents many accidents which lead to serious litigation.

The reflector can also be used on barricades on construction jobs and open bridges and on horse-drawn wagons and other vehicles.

Hoists for Single and Double Elevator Work

HOISTS with an exclusive bronze screw thrust controlling the asbestos lined cone clutch, have been developed by the Brown Clutch Co., Sandusky, Ohio, in its 1928 refined Model 20-A Brown Giant-Line hoist. By means of this arrangement, the full strength of the main shaft is retained throughout its length as the shaft is not drilled for the customary screw control.

Adjustment for wear of the cone lining is made by means of an ingeniously arranged gear integral with the bronze screw and pinion. Upon loosening two bearing cap nuts and a stud that holds the pinion, the operating levers can be placed in any position desired, at the same time providing a very fine adjustment between the drum and the cone. Anyone can make this adjustment in a few minutes' time without any way disturbing other parts of the hoist. If complete replacement ever becomes necessary, it is as easy as making the adjustment for wear and is not expensive.



A Model 20-A Brown Giant Line Hoist

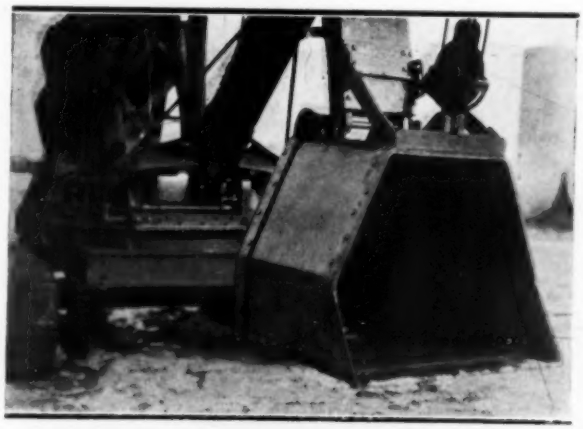
Other features of this hoist include bronze bushings in the drums, Alemite-Zerk lubrication throughout, full machine-cut gear drive, substantial cast gear guards, iron bed mounted on oak skids, a machined winch head, and ball thrust bearings for the elimination of friction, which means more power at the cable's end as well as relieving shock.

The Model 20-A and its companion, the single-drum Model 20, are equipped with 4-cylinder, 15-horsepower LeRoi radiator-cooled power units and are conservatively rated at 2,000 pounds single-line pull at 150 feet per minute with more than 33 per cent theoretical reserve or factor of safety.

These two units are recommended by the manufacturers for two wheelbarrow, single and double elevator work and all general purpose requirements within their capacity. Other types and sizes include single and multiple drum hoist units, non-reversible, reversible and conveyor.

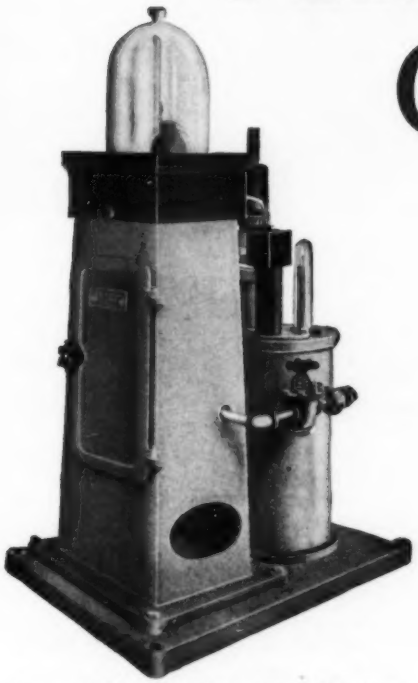
A Special Snow Scoop

A SPECIAL oversize bucket of a shape particularly suited for handling snow in city streets along curbs or gutters, has been developed by the Bay City Dredge Works, Bay City, Mich. The face of the bucket is 42 inches wide at the lips, tapering to 44 inches at the bottom, so as to insure easy dumping of the packed snow. The capacity is one cubic yard and as the Bay City tractor shovel has an operating speed of four to five trips a minute, depending upon local conditions, this machine can be expected to load a 5-cubic-yard motor



The New Bay City Oversize Snow Bucket

Automatic Chlorination



Automatic Vacuum Solution Feed Chlorinator
Type ASV

THE automatic application of liquid chlorine for water sterilization or sewage disinfection is desirable wherever there are rapid changes in the rates of flow or wide variations between maximum and minimum flows.

By eliminating the necessity of over chlorinating the low flows in order properly to chlorinate the high flows—as is frequently necessary with manually operated apparatus—the efficiency of the treatment is increased and interesting savings in chlorine result.

W&T Automatic Chlorinators are available to meet most water supply requirements.

Write for Technical Sheet No. 76

Efficiency Tests

on two of these units at the NEW HAVEN WATER COMPANY show an average accuracy of 99.5%.

"The only safe water is a sterilized water"

WALLACE & TIERNAN
COMPANY, INCORPORATED
Manufacturers of Chlorine Control Apparatus
NEWARK - NEW JERSEY

NEW YORK CHICAGO KNOXVILLE SAN FRANCISCO MINNEAPOLIS PITTSBURGH DALLAS KANSAS CITY
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WALLACE & TIERNAN, LTD., TORONTO, CANADA WALLACE & TIERNAN, LTD., LONDON, ENGLAND

5A5

truck in about two minutes' time, depending on the depth of the snow and whether or not a full bucket is secured every trip.

Practically every city has a snow loading problem after heavy storms and while equipment of the plow or scraper type can be used to advantage on open highways, the snow which accumulates along the curb on city streets after the merchants have cleaned their sidewalks and the street cars have cleared the tracks, all has to be loaded and hauled away. The Bay City snow bucket can be furnished as an extra bucket to be attached to any standard Bay City tractor shovel and the bucket can be put on in less than an hour's time.

A New Ready-mix Concrete, Rear-bottom Dump Body

DESIGNED to overcome the various difficulties encountered in the hauling of wet concrete, The Hug Co., Highland, Ill., has put on the market a new ready-mix

The Hug Ready-Mix Concrete, Rear-Bottom Dump Body with a Capacity of Two Yards of Wet Concrete

concrete, rear-bottom dump body, made exclusively for the Hug roadbuilder chassis.

The outstanding feature of this new equipment is that it remixes the concrete in the process of dumping, thereby overcoming any segregation of material that has taken place while in transit. The body dumps from the rear as in the conventional dump body; however, the upper portion of the body leaves the lower portion, the latter acting as a chute. The complete operation of the body is controlled from the driver's seat, and the entire body shell is elevated by toggle arms, and in such a manner that the batch in falling through rigid cross members of the body is thoroughly remixed and dumped.

Every feature of the dump body is automatic and the simplicity of construction with the absence of any levers or catches and the automatic raising and dumping, combined with the remix feature, made this new ready-mix body a most practical solution of wet concrete hauling.

A Power-operated Front Blade Backfiller

A BULLDOZER or front blade backfiller for attachment to the Model 20-K Cletrac tractor, has been produced by The Miami Trailer-Scraper Co., Troy, Ohio. It is a fast operating unit and is power operated.

The blade of this new backfiller is controlled by the power winch of this same manufacturer, which attaches to the power

The New Miami Bulldozer for the Model 20-K Cletrac

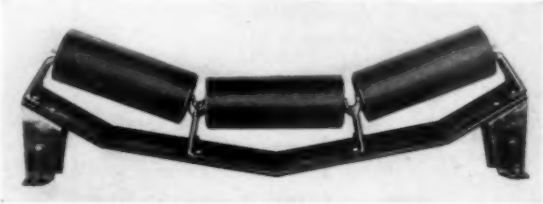
take-off on the rear of the tractor. The positive control of the blade through the winch enables the tractor operator to instantly raise or lower the blade as desired. The operator engages and disengages the clutch on the winch for raising or lowering the blade. This can be done with the tractor either in forward or in reverse motion, the tractor never stopping.

According to the manufacturers, one man, on an actual test using the Model 20-K Cletrac tractor and the Miami front blade backfiller, backfilled a sewer trench measuring 3 feet wide by 6 feet deep, at the rate of 100 feet per hour.

This new unit is not only suitable for trench backfilling work, but may be used for leveling purposes, for small grading operations, for spreading gravel, crushed stone, etc., for pushing dirt over fills and for moving snow.

A New Chilled Face Idler

A NEW anti-friction cast iron pulley, which has its outer surface of chilled iron, has recently been developed by the Stearns Conveyor Co., Cleveland, Ohio, and is being cast in the foundries of the Chain Belt Co., Milwaukee, Wis. In developing this chilled face idler, many difficulties have



The New Chilled Face Idler of the Stearns Conveyor Co.

been overcome and an exceptionally good chill has been obtained.

According to the manufacturers, it has always been difficult to put a good chilled iron surface on a small casting, particularly a shell, but the new pulley has a good depth of chill and the surface is extremely hard and will stand the most severe wear under a wide range of conditions from extreme heat to cold. It has a denser and tougher material than a common chill, capable of receiving a very high polish and contains as wear-resisting material as is commercially practicable today.

Within, the metal grades evenly to grey iron, giving the pulley a hard, smooth, wear-resisting surface with a relatively tough inside. The one-piece closed end design makes these pulleys practically unbreakable even under the most severe service.

A combination grease seal keeps dirt out of the bearings and keeps the grease in, making lubrication and attention necessary only at long intervals.

Stanolind Paving Asphalt used on this section

U. S. 131, between Ashton and Reed City, Michigan, constructed by the Michigan State Highway Department with

STANOLIND PAVING ASPHALT
AND
MEXICAN PAVING ASPHALT

Stanolind Cut-Back Asphalt was used as a primer coat on a compacted gravel base

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STANDARD OIL COMPANY
(INDIANA)

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ILLINOIS	INDIANA	IOWA	WISCONSIN	S. DAKOTA	MINNESOTA	MISSOURI
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Joliet	South Bend	Mason City	Green Bay	Detroit	Minneapolis	St. Louis
Peoria	KANSAS	Sioux City	N. DAKOTA	Grand Rapids		
Quincy	Wichita		Minot Fargo	Saginaw		

An Automatic Primer for Portable Pumps

THE automatic primer which has been developed by the American Steam Pump Co., Battle Creek, Mich., for use on the Barton pump, is one of the most valuable improvements of interest to contractors, as it permits the use of a centrifugal pump for pumping small quantities of water where under ordinary conditions the prime would be lost quite

The Barton Automatic Primer Showing Connection for Hose to Manifold

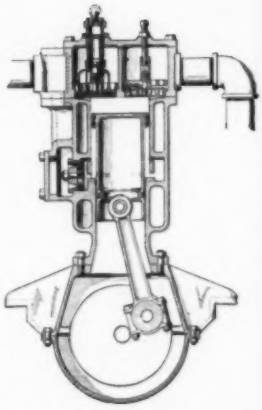
frequently. Where the pump is removing seepage from manholes or other excavation, the flap valve on the delivery line can be closed down to make delivery approximately correspond with the amount of water reaching the intake. The use of the automatic primer makes it possible to pump seepage water and keep the hole dry without an operator as long as the engine runs. When pumping is intermittent the action of the gravity flap valve in conjunction with the automatic primer insures continuous priming and the operation of the pump without supervision. When not in operation, both the pump and the primer are thoroughly drained.

The priming mechanism consists of the gravity flap valve on the discharge and a line from the automatic primer to the intake manifold of the engine. As soon as the engine is started the pump is primed by the air being removed from the suction line through the intake manifold. As soon as water reaches the cork float in the primer, it is lifted and immediately shuts off the line to the intake manifold of the engine, thus preventing any water reaching the engine. The instant the prime is lost, the float drops, suction to the intake manifold immediately takes place and continues until the water reaches the cork float.

The Barton pump, which is well-known for the ease with which it may be attached to the crankshaft of a motor truck or automobile and used to pump out trenches, excavations, cellars, etc., is one of the units of the new American-Marsh portable pumps which are built in several sizes and powered with a LeRoi 2- or 4-cylinder engine, depending on the size of the pump.

A Super-charger That Counteracts Air Losses

THE super-charger recently put on the market by the Independent Pneumatic Tool Co., 600 W. Jackson Boulevard, Chicago, Ill., for use with the Thor Six compressor, is designed to counteract the various losses in air delivery experienced in compressors. It is a device incorporated in the air cylinder, which add 26 per cent to the delivery volume, equivalent to a volumetric efficiency of 80 per cent in a 6-inch stroke compressor running at 800 r.p.m. against 100 pounds pressure, instead of the usual 65 per cent or less, heretofore obtained under the same conditions. This additional delivery of air naturally requires extra power, almost directly proportional to the added delivery. The extra power required is not in direct proportion, however, because the air in the super-charger is compressed on what is normally the idle stroke of the piston. By utilizing the idle stroke to do useful work, the mechanical efficiency of the unit is increased with the consequent saving in power.



The Thor Supercharger for Compressors

This Rix super-charger consists of an annular space at the lower end of the air cylinder, in which air is compressed on the down stroke by the lower side of the trunk piston. The area of the trunk piston is so proportioned that the amount of air displaced on the down stroke is one-third of the cylinder volume, the major portion of which is delivered through the flash port at the bottom of the main piston stroke, after the cylinder has been filled with air drawn in normally through its intake valves. This flash from the super-charger does three things—it throws about 25 per cent more air into the cylinder by raising the cylinder pressure to approximately 5 pounds gage pressure before the compressing stroke begins, and it snaps the inlet valves shut instantly, thus preventing valve slippage, which is a serious loss in high speed compressors.

The super-charger is simple in construction. There are no extra parts except one additional intake valve for each cylinder. These intake valves can be removed and the compressor will operate at the normal efficiency of a standard machine.

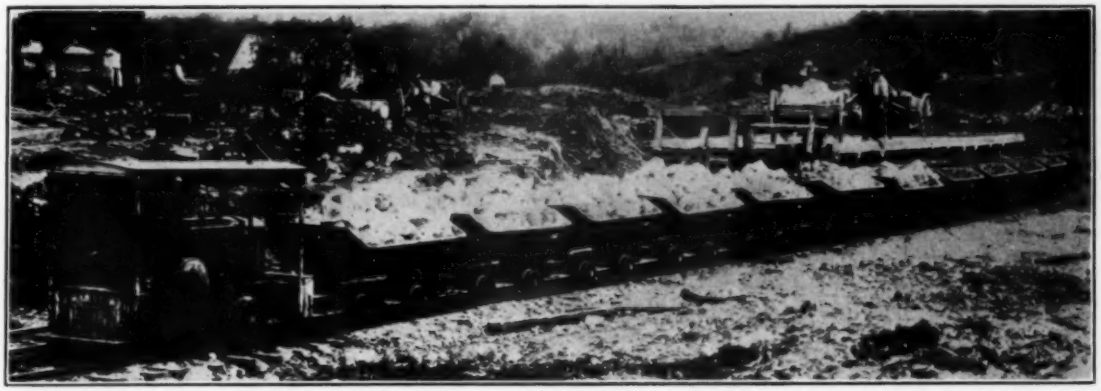
A New Kind of Finish-grader

THE Nu-Method finish-grader of A. W. French & Co., 8440 Lowe Avenue, Chicago, Ill., is a machine for cutting the finish or fine grade on which is to be laid a concrete slab or road. It is used after the rough grading is finished and forms have been set for the placing of concrete.

The machine travels on these forms and can be adjusted to cut the final grade accurately to the specifications both as to elevation and crown. It is self-propelling both forward and reverse, removing the dirt from the subgrade and delivering it

The Nu-Method Finish-grader Cutting Old Macadam

BROOKVILLE LOCOMOTIVES



5-ton Model "FDR" Fordson-powered

—Solves every hauling problem
—Does the work of a fleet of trucks at one-half the cost
—Speeds up completion of the job
—Guarantees efficient and reliable service

Broad power ranges—moves small industrial car with same ease as standard freight car rolling stock. All gauges from 18-inch to standard.
Made in models from 1½ tons to 12 tons with Ford truck, Fordson tractor, McCormick-Deering and International power units.

Consult us freely for expert advice on your individual hauling problems

BROOKVILLE LOCOMOTIVE COMPANY

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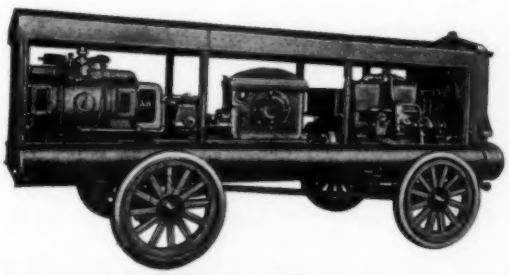
THE RIGHT COMPRESSOR FOR ALL KINDS OF PNEUMATIC TOOL WORK



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HORIZONTAL TYPE—DOUBLE ACTING—SLOW SPEED—STURDY AND RELIABLE—LONG LIFE—LOW UPKEEP.

THE TRAYLOR 12 in. x 10 in. PORTABLE COMPRESSOR

Will operate five rock drills, fourteen chipping hammers, or other pneumatic tools in proportion

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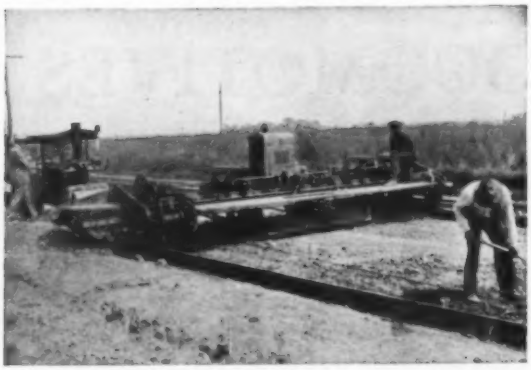


The Finish-grader Delivers All Spoil Outside the Forms

to a pile outside the forms on either side of the roadway. All operating levers are so placed that one man can easily operate the machine, requiring two helpers only when resetting the stakes, by means of which the grader is pulled forward. These stakes are usually set once for each 300 feet of roadway.

This new piece of road building equipment is so constructed that by means of ratchet handles attached to screws the entire machine is raised or lowered with respect to the forms, thus obtaining the required depth for the cut, and also when it is desired to remove the machine from the form, to permit the passage of trucks, it is raised enough to permit the placing of 48-inch-diameter moving wheels on the cross axle, and thus the grader can be moved on these large wheels, free of the forms, to one side of the road out of the way of trucks.

One thousand feet of 20-foot road can easily be finished by this finish-grader per day of 10 hours, occupying the time of one operator and two assistants or laborers.

The weight of the machine is about 7,000 pounds, but on account of its smooth working, freedom from vibration and sudden shocks, it does not throw the forms out of alignment nor disturb their placement for the pouring of the concrete slab after finish-grading has been completed.

By using the machine, the elevation of the subgrade is perfect with respect to the top of the form and later the thickness of the slab has practically no variation and the estimated and actual amount of material used will check very closely at the end of a day's run. The hardest and most difficult subgrade can be cut for a maximum cost of one operator and two laborers per 100 feet of road per hour, plus the use of the finish-grader, oil, gas, etc., thus accomplishing a saving by the use of the machine.

One Man Can Operate the Machine at the Rate of 100 Feet Per Hour

A Pivot Conveyor Trencher

A NEW trenching machine, featuring the "pivot conveyor," has been introduced to the field of digging equipment, by The Cleveland Trencher Co., 20100 St. Clair Avenue, Cleveland, Ohio. The new feature makes its possible for the conveyor handling the spoil, to swing in a 180-degree arc and discharge on to a truck alongside or ahead of the machine, while working at any depth, thus saving the cost of rehandling the material.

This new machine is a compact unit. It is less than an ordinary sidewalk in width, weighs less than 7 tons, and has reserve power and can dig trenches up to 10 feet in depth. The digging and loading is done in one operation, and the spoil bank can be located close to or away from the trench at either side.

A Cleveland Trencher Opening a Conduit Trench in a Sidewalk

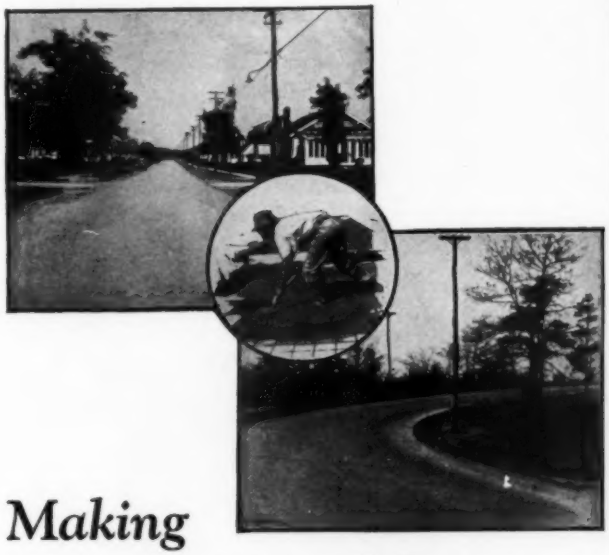
Other features of this Pioneer model are: full-crawler tracks that distribute the weight and permit quick, easy handling; single level control of trench depth; single lever control of steering; enclosed reduction units, run in oil; and 100 per cent special heat-treated alloy steel shafting. The tendency of the boom to "whip" has been eliminated. The boom slides upon two structural members which constitute an additional reinforcement and absorb the strains and shocks. Standard roller and ball bearings are used practically throughout. The operator's seat is conveniently located to all levers while affording a clear view of digging action as well as all parts of the machine. Alemite lubrication is used throughout. A Hercules Model "L" gasoline motor develops 38 horsepower at 900 r.p.m. The digging speed is from 3/8 foot to 8 feet per minute.

Articles to Appear in March

Forthcoming articles include: The Bull Run Dam, Breaking a State Highway Bottleneck, Moving a 3,200-ton Bridge 12 Miles, Unusual Road Project in Michigan, From Game Preserve to Water Power Development, Local Material Saves Road Project, The Pecos River Bridge Project, The Rehoboth Sand and Gravel Plant, Building Codes in a Changing Industry, The N. C.-Ky. Connection in Tennessee, Maximum Production of Concrete Pavement, The Health of the Man on the Job, Road Work in Erie County.

American Steel & Wire
Company's

WIRE FABRIC
"The Steel Backbone for Concrete"



Making City Street and Country Highway Permanent

TO reinforce concrete roads with Wire Fabric makes them permanent and is a proven economy. This fact is conclusively brought out in the report of the Highway Research Board, National Research Council.

Made of cold drawn high tensile strength steel, Wire Fabric has proved itself the perfect slab reinforcement. It gives the most effective distribution of steel—the closely spaced wires insuring greatest binding strength, holding the slab together as a solid unit and preventing the development of cracks.

Wire Fabric means permanent reinforcement—longer concrete life—lower maintenance costs. It is furnished in sheets cut to definite size which are easily handled and placed.

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		WORCESTER	94 Grove Street
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BIRMINGHAM	Brown-Marx Bldg.	*SAN FRANCISCO	Russ Bldg.
MEMPHIS	Union and Planters Bank Bldg.	*LOS ANGELES	2087 E. Slauson Ave.
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DENVER	First National Bank Bldg.	*SEATTLE	4th Ave. So., & Conn. St.
SALT LAKE CITY	Walker Bank Bldg.		

*United States Steel Products Company.

Russell Records Grow

10 states that lead in the use of RUSSELL MOTOR PATROLS

California	40
Delaware	24
Florida	16
Illinois	51
Iowa	86
New Jersey	69
Ohio	110
Texas	24
Washington	56
Wisconsin	96

East and West--Jersey (69) and California (40)
North and South--Wisconsin (96) and Texas (24)
Central States--Ohio (110) and Illinois (51)

Where Road Maintenance is Most Active there RUSSELL Motor Patrols are Paramount

Actual purchases by others is convincing evidence and you may well consider this in your own maintenance work—that is all we presume to suggest.

From every angle Russell Motor Patrols are proving to be the ideal maintenance equipment—sturdy and efficient with weight where it counts—speed and adaptability to actual road conditions.

With these highly finished machines comes refinement of design eliminating mere clumsy weight—machines which give speed and ease in control and a standard of efficiency which can scarcely be overestimated—then too, they afford a minimum of up-keep cost.

Here are specifically some of the dominating features—cut gears completely enclosed, Timken bearings, bronze bushings and collars for worm shafts, ball and socket connections in lifting links, tight joints, large circle for blade and long wheel base.

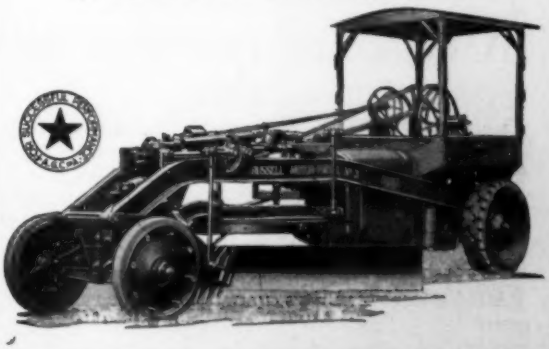
The complete Russell Line for Road Construction and Road Maintenance includes—

4 Sizes Motorized (Unified) Road Machines
10 Sizes Road Machines (for Horse or Tractor Power)
3 Sizes Elevating Graders

Scarifiers, Road Drags and Wheel Scrapers, Drag Lines, Conveyors, Gravel Screening, Crushing and Loading Equipment, Etc.

Russell Grader Manufacturing Company

Factory and General Offices—
MINNEAPOLIS, MINNESOTA
Representatives and Warehouses in all principal cities



Heil Hydro Hoist with Barrymore Mixer on Blue Diamond Truck

Fast, Efficient Hoist Aids Concrete Mixing System

READY mixed concrete that is satisfactory to owners, architects, engineers and contractors has been made possible by the various units which go toward making up this certified concrete mixing system. This system is used by the Blue Diamond Co. of Los Angeles, Calif., with its new fleet of AXX Moreland trucks equipped with Heil hoists and Barrymore mixers.

In this system, the dry mix is quickly dumped into the mixer at a central proportioning plant and, while enroute, water is added and the cement thoroughly mixed, so that when the truck reaches its destination, the concrete is ready to be poured. This system saves the cost and expense of maintaining concrete mixing units, and eliminates the blocking of sidewalks and streets with piles of rock and sand.

The hoists are a product of The Heil Co., Milwaukee, Wis., and have a two-year guarantee rigidly adhered to. The expense incurred in their upkeep is practically nil, as the only two wearing parts operate in a bath of oil. The hoist is especially fast, as it will lift a load to the full dumping capacity in less than ¼ minute.

Other added features of this hoist are its simplicity of mechanism and operation. It has twin cylinders, and it applies its lifting effort in a straight line to the load itself at all angles of the dumping operation, thus assuring tremendous power. As the mixers weigh 4500 pounds and are higher than the ordinary body, the center of gravity had to be made lower. In making the selection of this hoist, the Blue Diamond Co. also specified that the body should not extend above the truck cab, and this has been taken care of through the use of this hoist.

A Gasoline-powered Saw Table

A CONTRACTORS' saw table that is easily portable and is powered by an air-cooled gasoline engine, has been produced by the Jones Superior Machine Co., 1258 W. North Avenue, Chicago, Ill. The Speedster saw table is particularly serviceable on small operations as it can be pushed around the job like a wheelbarrow and is sturdy enough to stand rough handling.

A 1½-horsepower Briggs & Stratton gasoline engine furnishes power for the unit. When equipped with this engine, the Speedster will rip 2-inch lumber at the rate of 20 feet a minute and will cut off 3 x 6's in less than two seconds. One great advantage of a power saw of this type is that more accurate work can be accomplished than by a hand saw. It is no trouble for even the most inexperienced workman to operate this more accurately than a skilled workman can his best tools.

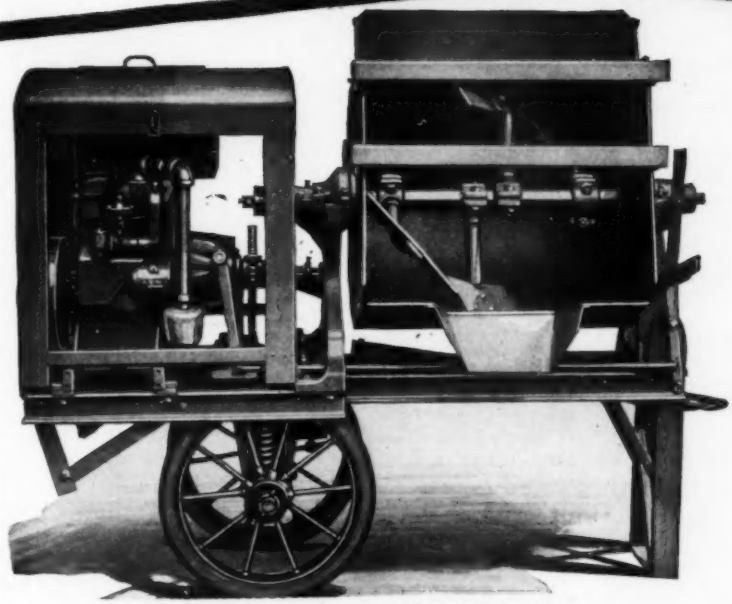
This machine, which is practically all of steel, is especially desirable where electric current is not readily available. The table is made of heavy steel and has been Parkerized, which makes it rust proof. It tilts sideways to 45 degrees. The handle for pulling the saw through the work also acts as the splitter guard. This can be removed for dadoing. The cross cut and mitre gage can be swiveled by any angle. It can be located in two positions, for wide or narrow work.

A 10-inch combination rip and crosscut saw is furnished with each machine. The ripping gage is adjustable for either side of the saw. The saw arbor is mounted on Timken roller bearings. The base and frame are electrically welded into one solid piece. Ample provision for sawdust is afforded. Wheels and levers make the moving of the saw a slight operation. The right hand lever also adjusts the saw arbor up and down to get the correct depth of the cut. The oil reservoir will hold sufficient oil for 20 hours of continuous running.

The Superior Portable Saw Table

German Steam and Motor Road Rollers in Action at the Last Leipzig Fair, Germany. The Next Industrial Fair is to be Held March 4-10, 1928

THRUADOOR



Write today! For the new BLYSTONE Circular

BLYSTONE MFG. CO., Cambridge Springs, Penna.

Phone Walnut 1630

F. A. WEAKE, INC.

Contractor for

PLAIN AND DECORATIVE PLASTERING

293 Bridge Street
Springfield, Massachusetts

February 22, 1927.

Blystone Manufacturing Co.,
Cambridge Springs, Pa.

Gentlemen:

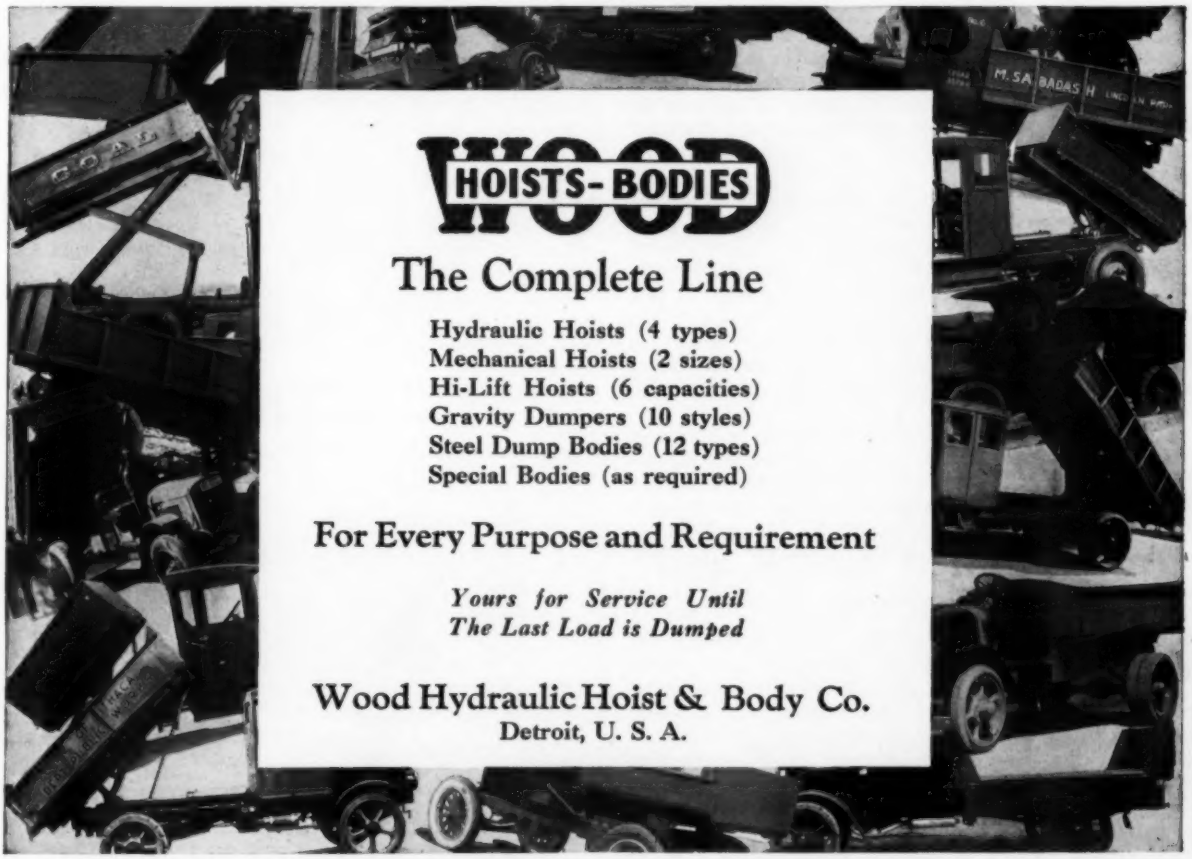
In reply to your letter of February 19th in which you ask us just what we think of the Blystone Plaster Mixer you sold to us a year ago.

We are very pleased to say this machine has given us A-1 Service. We have kept it in constant use and the results have been very gratifying as this machine paid for itself on the first job. This machine has done more than you claimed for it.

Yours very truly,

F. A. WEAKE, INC.,
By: F. A. Weake.

FAW:RN



WOOD HOISTS-BODIES

The Complete Line

Hydraulic Hoists (4 types)
Mechanical Hoists (2 sizes)
Hi-Lift Hoists (6 capacities)
Gravity Dumpers (10 styles)
Steel Dump Bodies (12 types)
Special Bodies (as required)

For Every Purpose and Requirement

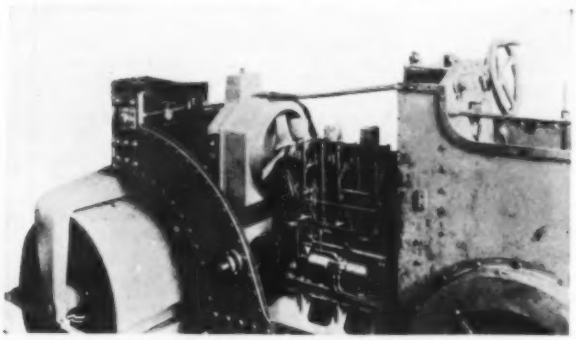
Yours for Service Until
The Last Load is Dumped

Wood Hydraulic Hoist & Body Co.
Detroit, U. S. A.

A New Airless Injection Diesel Engine for Construction Equipment

THE Colo-Diesel engine, a 4-cycle, airless injection machine of small bore and high speed, adaptable to mobile equipment and stationary service requiring small units, has recently been placed on the market in the United States through F. van Rossen Hoogendyk, Graybar Building, New York. This diesel engine is furnished with 1, 2, 3, 4 and 6 cylinders, all having the same bore and stroke dimensions. It is rated to deliver 10 brake horsepower per cylinder at 800 r.p.m. The weight of the 4-cylinder engine, including the flywheel, silencer, fuel tank and spare parts, is 1800 pounds, a figure corresponding to about 45 pounds per brake horsepower for the complete installation.

Individual cams drive the fuel pumps which are equipped



The Colo-Diesel Engine Mounted on a Road Roller

with a hand lever for priming and for throwing each pump separately out of commission by raising up the roller. A somewhat unusual method of regulating the pumps consists in the use of a static by-pass needle subject to hand or governor control. The wider the needle is open the less oil is forced to the injection valve. Outside of the pump plunger and the usual suction and discharge valves, there are no moving parts on the pump.

A cylindrical cup on top of the piston dips into the open throat of a pre-combustion chamber, closing the latter on all sides. At about dead center of the piston, the fuel is injected sharply against the bottom of the cup, whereby excellent atomization and turbulence is attained. During the injection, the pre-combustion chamber is entirely or almost closed and only at the beginning of the down stroke, radial holes in the cup connect the pre-combustion chamber with the cylinder. There are no small holes in the fuel nozzle, which is kept clean mechanically.

The Colo-Diesel engines are used extensively in Europe in road-rollers, small locomotives, cranes, tractors, and further for direct connection to electric generators, compressors, pumps, etc. Stationary units are provided with pulley for belt drive.

A Combined Truck and Tractor

ESPECIALLY designed for the small contractor is a new crawler truck of the Law Manufacturing Co., 236 West 55th Street, New York. It is known as the Law creeper truck and is powered by the Fordson tractor. It is a powerful unit with the pay load used to obtain the necessary traction for drawing road graders, scrapers, trailers, and other equipment. Its design is simple, it is rugged in construction, is built for wear and has few working parts, with the resultant low maintenance cost.

The creeper wheel is of the rigid, self-supporting type, so

The Law Creeper Truck with Easton Roll-over Body

designed as to eliminate the rollers, thus reducing friction to a minimum. The only rollers in the creeper wheel are the Hyatt bearings in the wheel hubs. The creeper truck is non-clogging, even in the deepest mud. The unit is equipped with a pressure lubricating system. Adjustment is effected by means of eccentric bushings.

This creeper truck offers a wide range of usefulness in the field. It can be equipped with stock bodies of the roll-over, gravity- or power-hoist types, in capacities of 3 cubic yards. It can be used either as a straight hauling unit, or as a combination hauling unit and tractor. It is especially suitable for land development, road building, and in sand, gravel and clay pit work. It is equally as serviceable on bad roads, cross country and good roads.

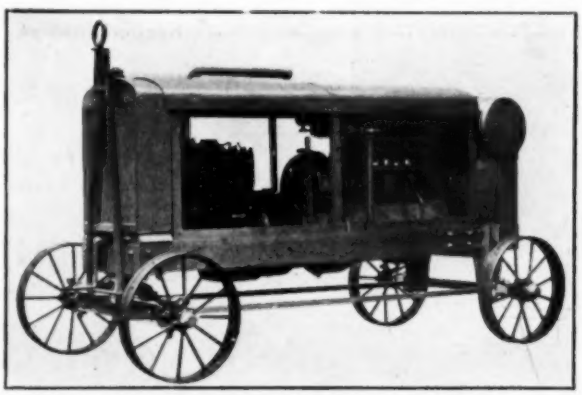
A Pump Built on Automotive Principles

CONTRACTORS who want machinery that will give the maximum service with the least possible maintenance and up-keep cost, will find the new Durex pump of C. I. Longenecker, manufactured by the Chain Belt Co., 766 Park Street, Milwaukee, Wis., an adequate and economical piece of equipment. This newly designed pump is built on the automotive principle and will supply sufficient water to operate a 27-E paver.

The pump has all its working parts completely enclosed. A separate oil pump supplies oil to the working parts, assuring the owner that his pump is constantly lubricated. The mounting of the Durex is unique in that it is equipped with springs and has a knuckle-type front axle. A spring drawbar with a heavy eye-bolt is also furnished.

Power is supplied for the pump by a 35-horsepower heavy-duty Waukesha motor. A Twin Disc clutch is mounted between the engine and pump, which permits greater facility in starting.

The capacity of the pump is 80 gallons per minute or 4,800 gallons per hour at any pressure up to 500 pounds.



New Portable Durex Pump with Waukesha Motor

"How Good?"

is a bigger question than "How Much"

The first thing you look into, when buying a bucket, is *the service that other owners have received.*

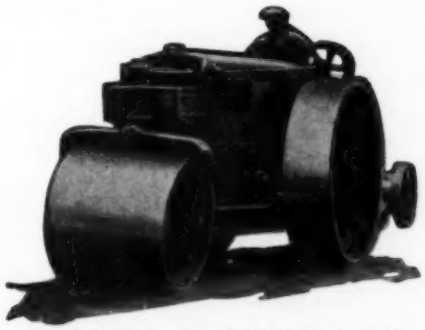
Thousands of men have learned to count on Williams Buckets for the kind of performance that Mr. Crout writes about:

"Our WILLIAMS Bucket bought in 1911 is still giving good service—and we have just placed an order for our 6th WILLIAMS Bucket."
E. E. Crout, Columbia Digger Co., Portland, Ore.

When you want service like this, you don't buy a bucket that is built down to a price, but one that is built up to a reputation.
The best bucket that can be built.

WILLIAMS
FAST-DIGGING BUCKETS

G. H. WILLIAMS COMPANY
609 Haybarger Lane, Erie, Pa.
Branch Offices: New York, Pittsburgh, Cleveland, Chicago



One of the leading Buffalo-Springfield models. Send for literature.

Reputation

Buffalo-Springfield Road Rollers have held the position of leadership in the field for more than thirty years and they lead today as formerly. Investigate and you will find Buffalo-Springfields more frequently specified than any other make—because they embody the most advanced features of design and construction—and because they are unquestionably the most dependable "out on the job."

Latest types and all practical sizes. Scarifiers and other attachments when specified.

Illustrated literature ready to mail. Write us.

The Buffalo-Springfield Roller Co., Springfield, Ohio

Buffalo-Springfield

ROLLERS

Contractors! Yours for the Asking

These especially selected catalogs and pamphlets of value to contractors are for free distribution. You will find it worth while to check these lists each month and write for the catalogs you need.

BULLETIN ON CONTRACTING AND DIRT MOVING
The Trackson Co., 519 Clinton Street, Milwaukee, Wis., manufacturers of Trackson all-steel crawlers for Fordsons which have a patented non-clogging track of specially hardened alloy steel, greater track area and oil reservoir type dirt-proof bearings, will be pleased to send to contractors interested a copy of the special free bulletin on contracting and dirt moving which they have issued.

HIGH SPEED CRANES
The Koehring Co., Milwaukee, Wis., manufacturers of Koehring heavy duty, high speed cranes with finger-tip control that means speed and accuracy of operation with orange-peel or clamshell, magnet, pile-driver or other equipment, will be pleased to send without obligation a copy of Crane Bulletin Cr. 6 to interested contractors.

A SKIMMER-PULLSCOOP
The double-barreled skimmer-pullscoop Keystone excavator, that has a Lasky 57-horsepower gas engine and is built with a long wheel base and half-crawler mounting, is described in literature which the Keystone Driller Co., Beaver Falls, Pa., will be glad to send on request.

A 35-H. P. GASOLINE HOIST
The Flory 35-horsepower gasoline hoist, as well as steam, electric and other gasoline hoists of the S. Flory Mfg. Co., Bangor, Pa., are described and illustrated in literature that is free to interested contractors and engineers.

PIPE, FITTINGS AND PUMPS
Quick, safe and economical steam-jacketed pipe, fittings and pumps, as well as the complete Iroquois line of road-building machinery, are described in literature of the Iroquois Sales Department, The Barber Asphalt Co., Philadelphia, Pa., which is free on request.

CONCRETE ROAD FINISHERS
Ord concrete road finishers which can be used for roads from 9 to 30 feet wide, for finishing the full width, for half the road or for adding a strip to an already existing road and which are sturdily built, are described in literature which may be secured without obligation from A. W. French & Co., 8440 Lowe Avenue, Chicago, Ill.

A NEW WATER-HAMMER DRILL
The new Sullivan T-3 water-hammer drill which is the latest development in a drifting or tripod drill for quarrying and contracting service, such as tunnels, shafts or open-cut excavation, is completely described in Bulletin No. 81-M which may be secured from the Sullivan Machinery Co., 162 So. Michigan Avenue, Chicago, Ill.

IMPROVED METHOD OF BITUMINOUS PAVING
Contractors and city officials interested in an improved method of constructing a bituminous surface on a concrete base which produces a dense, super-strong concrete base with a bituminous surface immovably interlocked, should secure a copy of the booklet describing Interlocking bituminous pavement from the American Vibrolithic Corporation, Des Moines, Iowa.

2-IN-1 PLOW WITH ONLY NINE PARTS
Wiard's 2-in-1 Super plow which has only nine parts and can be used with horses or mules, tractors, road rollers or drag lines, is completely described in the booklet of the Wiard Plow Co., Batavia, N. Y.

NEW LINE OF 4-CYLINDER ENGINES
A new 4-cylinder engine recently announced by the Novo Engine Co., Lansing, Mich., has been added to the line of Novo Roller industrial engines for 1928. They are of the 12 and 16-horsepower capacities, have Timken roller bearings on the crankshaft, positive-driven oil pump, drive-shaft speeds from 300 to 1200 r.p.m., and are described in literature which may be secured from this company on request.

REMOVABLE PLUGS FOR MAINS
The Safety Gas Main Stopper Co., 523 Atlantic Avenue, Brooklyn, N. Y., will be pleased to send complete information regarding the use of the Goodman cylindrical stoppers for gas, oil, water and drain pipes when repairs are being made.

FREE CONCRETE AND LUMBER SCALE
The Pennsylvania-Dixie Cement Corporation, 131 East 46th Street, New York, will be pleased to send one of its concrete and lumber scales which gives the quantity of clean graded sand and stone or pebbles required for one cubic yard of concrete of different mixes and also the quantities of material needed for one hundred square feet of wall or floor of different thicknesses.

REVOLVING TRACTOR SCRAPER EASILY CONTROLLED
The Ground Hog revolving tractor scraper made by the Roderick Lean Co., Mansfield, Ohio, and which has a long lever that positively regulates the depth of cut, is completely described in literature which may be secured from the manufacturer free on request.

A DITCHER THAT HELPS TO HAVE MONEY
Bulletin 2126 issued by the Parsons Co., Newton, Iowa, gives complete facts on the Public Service ditcher, which can put a trench only 7½ inches from poles or trees, can dig practically all the trench that used to be left for the hand gang and helps to save money on every trench job.

BUCKETS OF ALL KINDS FOR CONTRACTORS
The Hayward Co., 32-36 Dey Street, New York, will be pleased to send complete information and prices on its complete line of clam shell, orange peel, drag line and electric motor buckets, dredging, excavating and coal handling machinery, automatic take-up reels and counter-weight drums, to contractors interested.

FOR CUTTING CONCRETE AS WELL AS COSTS
The Thor 6 compressor and paving breaker is the only compressor with a super-charger, which enables it to deliver 26 per cent more air, has both engine and compressor mounted on a common crank-case, eliminating gears, clutches and couplings, and has an absence of vibration. It is described in Bulletin 103 of the Independent Pneumatic Tool Co., 600 West Jackson Boulevard, Chicago, Ill.

A NEW CONCRETE MIXER
The new No. 3½ Kwik-Mix trailer concrete mixer, featuring the new friction tilting device, that gives more speed, greater ease and better work, is described in a new catalog which the Kwik-Mix Concrete Mixer Co., Port Washington, Wis., will be glad to send on request.

ROAD MAINTENANCE AT LOW COST
The new catalog of Hawkeye Maintainers, telling the whole Hawkeye story and describing the complete line of machines in all sizes for all maintenance purposes, is now ready and a copy may be secured from the Hawkeye Maintainer Co., Waterloo, Iowa, free on request.

HOW TO CURE CONCRETE
This is the title of a manual of instructions on the curing of concrete pavements, containing numerous illustrations, charts, and diagrams dealing with practical, everyday problems, which may be secured free by writing to the Dow Chemical Co., Midland, Mich., manufacturers of Dowflake calcium chloride for curing concrete.

SHOVELS FOR GRADING AND OTHER HEAVY WORK
Literature describing the Bear Cat Skimmer, which shows speed and economy on shallow grading, and can be converted into a ditcher or crane, and the Massillon Master, a gas shovel of big capacity, with speed, power and flexibility for heavy work, may be secured from the Byers Machine Co., Ravenna, Ohio.

PLASTER AND MORTAR MIXERS
The new M-B mixers for plaster and mortar, that are distinguished for sturdiness, simplicity and volume and that mix patent plaster thoroughly owing to the conformation of the revolving drum, are described in literature of The Meili-Blumberg Co., Inc., New Holstein, Wis.

CONCRETE BLOCK MACHINERY BUILT FOR SPEED AND EFFICIENCY
Literature and information may be obtained free from the Cement Block Machinery Co., 17 Durand Street, Newark, N. J., describing National concrete block machinery that is dependable, fast equipment for every size plant, and that gives high production per dollar of cost.

HAVE YOU A BOILER PROBLEM?
If you have a boiler problem that requires immediate and satisfactory solution, get in touch with Johnston Bros., Inc., Ferrysburg, Mich., specialists in boilers for contractors' equipment, who will give information and send literature free on request.

BITULITHIC PAVEMENT FOR DEPENDABLE SERVICE
Warrenite-Bitulithic pavement that has stood the tests of time and is appreciated by engineers and contractors as a dependable and durable basic theory in pavement construction, is described in literature of the Warren Brothers Co., Boston, Mass.

A PORTABLE OIL BURNING HEATER
Style "J" portable oil-burning heaters that give lower cost and better work and are designed exclusively for oil as fuel, are described in the "Blue Book" of Connery & Co., Inc., 4000 N. Second Street, Philadelphia, Pa., which also describes the many tar and asphalt heaters of this company.

LOCOMOTIVES FOR EVERY CONTRACTING NEED
Facts and figures regarding Brookville locomotives made in fifteen standard models from 1½ to 12 tons, suitable for handling from one small industrial car up to heavy-duty requirements, may be secured without obligation from the Brookville Locomotive Co., Brookville, Pa.

HOISTS AND BODIES FOR DUMPING EQUIPMENT
Bulletin 179, issued by the Heil Co., 1242-60 26th Avenue, Milwaukee, Wis., gives complete information and details regarding Heil hoists and bodies for every dumping problem. Copies will be sent free on request.

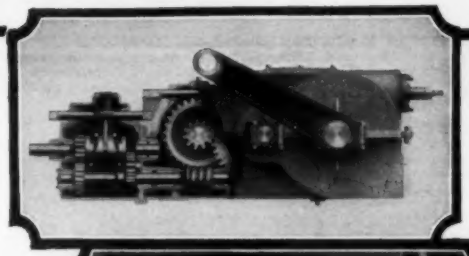
COLD WEATHER CONSTRUCTION
Hauck oil-burning concrete heaters, salamanders, and thawing outfits that burn kerosene or furnace oil, are described in a free booklet of the Hauck Manufacturing Co., 126-134 Tenth Street, Brooklyn, N. Y.

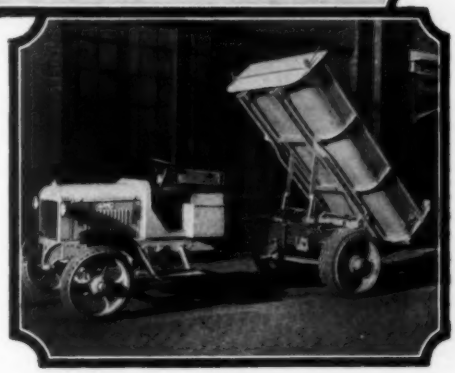
TRENCHING BRACES WITH FORGED STEEL SCREWS
Trenching braces with forged steel screws, and timber brace fittings that are suitable for use in any but very narrow trenches, are described in a circular of the Kalamazoo Foundry & Machine Co., 578 East Main Street, Kalamazoo, Mich., which is free on request.

STEEL GRATING AND FLOORING
Steel grating and flooring that is one-piece, electro-forged, has a perfect protection against rust, and gives more light and better ventilation because of its construction, is described in a booklet of Blaw-Knox Co., 667 Farmers Bank Bldg., Pittsburgh, Pa., which is free to interested contractors and engineers.

BLADES FOR ALL MAKES OF GRADERS OR DRAGS
Grader blades for all makes of graders or drags, grader moldboards, steel frames, grader structurals, scarifier teeth, etc., are described in literature of the Shunk Manufacturing Co., P. O. Box 37-B, Bucyrus, Ohio.

Hoist and Body Units That Pay Real Profits





VAN DORN hoist and body units are profit producers because their action is positive and trouble-free because they are built to stand the gaff of hard, continuous service.

Constantly bathed in oil and operating on the worm gear principal the hoist mechanism cannot be surpassed for service. The body itself, while lighter than ordinary truck bodies, has a strength far out of proportion to its weight.

A Van Dorn mechanical hoist plus a Van Dorn body is a combination that means real profits for the operator.

THE VAN DORN IRON WORKS CO.
2685 E. 79th St. ***Truck Division*** **Cleveland, Ohio**

"More Pay Loads—More Profits"

Van Dorn
MASTERCRAFTSMANSHIP IN STEEL

ACCEPT NO SUBSTITUTE

Sterling

"handle clamps" reinforce the handles — no breakage — longer life — therefore far cheaper per job.

Sterling handles fit into the steel channel leg frame snugly and are held by a reinforcing clamp *surrounding both.* There's *no weak point,* here, as is found in bolted handles.

Sterling barrows *always cost less per job.* If you doubt it—try them out on your next job—compare them with any other—you'll find them better and you will get more work out of them.

Leading Hardware and Equipment dealers have them — or they can get them quickly from our complete stock warehouses at — Chicago — New York — Philadelphia — Pittsburgh — Cleveland — Detroit — St. Louis.

—all barrow parts are fully interchangeable

STERLING WHEELBARROW COMPANY
STERLING ON A WHEELBARROW MEANS MORE THAN STERLING ON SILVER
Milwaukee Wisconsin

RULES AND TAPES FOR ACCURATE MEASUREMENTS
Aluminum rules in 10ths and 100ths of feet, and tapes for every purpose, are described in a catalog of The Lufkin Rule Co., Saginaw, Mich., which will be sent free to interested contractors, engineers, highway builders, tile layers, etc.

AN AUTO HEATER AND DISTRIBUTOR
The Kinney heater and distributor that will properly heat and apply the heaviest asphalts and tars as well as the lighter grades of bituminous material with economy and efficiency, is described in a booklet of the Kinney Manufacturing Co., Boston, Mass.

GUARANTEED CLAM SHELL BUCKETS
Kiesler clam shell buckets, that are built to give the maximum service and are guaranteed, are adequately described in literature, which the Jos. F. Kiesler Co., 936 W. Huron Street, Chicago, Ill., will be glad to send to interested parties.

A NEW COLUMN CLAMP
The new Williams column clamp that is made in one size only, and can be made to fit any size column, that is made with teeth on the upper and lower surfaces, the one straight and the other diagonal, is described in a circular of the Hawley Manufacturing Co., 26 W. Kinzie Street, Chicago, Ill.

AN EASY-RUNNING, TIME-SAVING DRILL
The Hardsocg wonder drill that is a time-saver on the most difficult jobs, is a small air-consumer, is easy to handle, smooth-running and trouble-free, and has less parts than usually found in drills, is described in literature of the Hardsocg Wonder Drill Co., Ottumwa, Iowa.

A PORTABLE CRUSHING PLANT AND A SAND SPREADER
A portable gravel crushing plant that is self-propelled, capable of being operated directly in a gravel pit and readily moved from place to place to keep close to its work, and a new sand spreader which, with one loading, will spread a 9-foot strip of sand for a distance of three miles, are described in literature of The Good Roads Machinery Co., Inc., Kennett Square, Pa.

SAVING PUBLIC FUNDS
"Industrial Units" is the title of a free book of the Waukesha Motor Co., Waukesha, Wisc., which shows some of the thirty-two different industries in which Waukesha power is used, and describes the portable, heavy,-duty gasoline engine of this company, which is a great man, power and money saver in handling tough snow removal jobs with reliability and speed.

HOIST AND BODY UNITS THAT PAY REAL PROFITS
Van Dorn hoist and body units that are profit producers since their action is positive and trouble-free because they are built to stand the gaff of hard, continuous service, and that have the hoist mechanism constantly bathed in oil and operating on the worm gear principle and with a body that has a strength far out of proportion to its weight, are described in literature of The Van Dorn Iron Works Co., Truck Division, 2685 East 79th Street, Cleveland, Ohio.

A ROAD BUILDERS' PUMP
A special descriptive bulletin of the Domestic Engine & Pump Co., Shippensburg, Pa., which gives details of the road builders' ideal pump, the "Domestic," "Giant," triplex pump that comes in five sizes with a capacity and pressure to meet every requirement, will be sent free to engineers and contractors.

A BUCKET THAT DOESN'T PULL IN AT THE SIDES
The new bucket book of the G. H. Williams Co., 609 Haybarger Lane, Erie, Pa., describes the "double-arch" dragline bucket that doesn't pull in at the sides, has a rigid one-piece bridge, reinforced by a heavy special alloy steel digging lip, as well as other buckets of this company.

A COMPLETE LINE OF EXCAVATING MACHINES AND CRANES
Literature of the Bucyrus-Erie Co., Milwaukee, Wis. and Erie, Pa., describing the complete line of excavating machines and cranes, that is backed by long manufacturing experience and service facilities, is available, free on request, to interested contractors and engineers.

ASPHALT PRODUCTS FOR PERMANENT HIGHWAYS
Asphalt binder, cold patch asphalt, refined Mexican asphalt, asphalt joint fillers, paving flux, bridge asphalt and preserving oils are described in literature of the Standard Oil Co. of New York, 26 Broadway, New York, which is free on request, to interested contractors and engineers.

WIRE ROPE FOR MATERIAL HANDLING
The Telfax text book on wire rope, which tells all about wire, Telfax tape marked rope for conveyors, hoists, elevators, draglines, shovels and many other construction purposes, will be sent on request, by the Williamsport Wire Rope Co., Williamsport, Pa.

A TRUCK FOR EVERY TYPE OF ROAD WORK
White trucks for low cost road building, of rugged construction, low chassis weight and built for every type of road work, are described and illustrated in literature of The White Co., Cleveland, Ohio.

PROFITS WITH HOISTS
Reversible and non-reversible hoists, single and double drum, with or without engine, and made in two sizes, 1200 to 2000 pounds capacity, are described in literature of the Universal Hoist & Manufacturing Co., 200 East 14th Street, Cedar Falls, Iowa.

WATER METERS, VALVES, PIPE-LINING EQUIPMENT, ETC.
Catalog G-57 of the Union Water Meter Co., Worcester, Mass., gives complete information of water meters, valves, stops, pipe lining equipment and fire whistles.

A POWER SHOVEL WITH TELESCOPING HANDLE
A catalog and complete information regarding Star power shovels with patented telescoping handles, will be sent to interested parties, by The Star Drilling Machine Co., 505 Washington Street, Akron, Ohio.

DUMP BODIES FOR THE NEW FORD
Eagle dump bodies for the new Ford truck, that are especially designed for work delivering aggregate to the paver, and will get out the maximum amount of haulage, are described in literature of The Eagle Wagon Works, Auburn, New York, which is free on request.

A COMPLETE LINE OF DERRICKS AND WINCHES
A complete line of derricks and winches is described thoroughly in free literature of the Sasgen Derrick Co., 3101 Grand Avenue, Chicago, Ill., which is available to interested contractors and engineers on request.

DAYLIGHT AT NIGHT
Contractors, street repair gangs, tunnel workmen and many other night workers are finding the National carbide lantern of the National Carbide Sales Corporation, 342 Madison Avenue, New York, the nearest approach to sunlight ever found in a lantern. The many features of these lanterns are described in free literature of the company.

FAST AND ECONOMICAL ROAD BUILDING
Literature describing Euclid wheelers that move earth quickly and economically and, are built to withstand the most severe strains imposed by the heaviest tractors, as well as heavy-duty wheel scrapers, rotary fresnos and all-steel, tractor-drawn dump wagons, will be sent free by the Euclid Crane & Hoist Co., Euclid, Ohio.

WIRE FABRIC FOR CONCRETE
Wire fabric for making city streets and country highways permanent, that lengthens the life of concrete and reduces maintenance costs, and that is furnished in sheets cut to definite size which are easily handled and placed, is described in literature of the American Steel & Wire Co., 208 So. La Salle Street, Chicago, Ill.

A HEAVY-DUTY TRAILER
Heavy-duty Gooseneck trailers that are re-enforced at every point to insure maximum strength, that transport enormous weights, yet are designed to save loads, roads, time and money, are described in free literature of the Rogers Brothers Corporation, Albion, Pa., which will be sent to interested contractors and engineers.

A PERMANENT TAIL LIGHT
The Persons vehicle reflector, manufactured by the Persons-Majestic Manufacturing Co., Worcester, Mass., is a double prismatic reflector for attaching to the rear of trucks and which is brilliant at 500 feet. Literature describing this will be sent on request to contractors and city officials interested.

A TRACTOR AND CRANE COMBINATION
The Tractocrane of The Vergan-Schmidt Co., Champaign, Ill., that is a highly portable unit available with McCormick-Deering or Fordson power unit on rubber-tired wheels, semi- or full-crawler traction, that is one-man operated, has low initial cost and speed of operation, is described in literature that is free on request.

A PORTABLE COMPRESSOR THAT SAVES COSTS AND TIME
Actual figures on cost savings in many kinds of work with the Curtis portable compressor, that saves the cost of a special operator, are available free to interested engineers and contractors, by the Curtis Pneumatic Machinery Co., 1931 Kienlen Avenue, St. Louis, Mo.

LOWER PRICES ON MIXERS
Send today for your copy of the catalogs on Jaeger mixers, which describe the line of non-tilt mixers, plaster mixers, or tilting mixers of the Jaeger Machine Co., 701 Dublin Avenue, Columbus, Ohio, on which there are new low prices on many sizes, timken bearings and automatic skip shakers.

A SHOULDER MAINTENANCE MACHINE
The Brabazon Manufacturing Co., Stoughton, Wis., has developed a shoulder maintenance machine which is quickly attached to the rear of any 3½ to 5-ton dump body truck. This machine quickly and uniformly applies the necessary maintenance material to the shoulder of a road in just the right quantities and levels it automatically. The machine is completely described in literature which may be secured free on request.

HOISTS AND COMPRESSORS FOR EVERY USE
The O. K. line of hoists and compressors that come in a variety of sizes for every use in the construction field, is described and illustrated in the catalogs of the O. K. Clutch & Machinery Co., Columbia, Pa.

A TRAILER FOR EVERY HAULING NEED
Highway trailers that are dependable, durable and suited to the many needs of hauling, are described in literature which the Highway Trailer Co., 503 Fulton Street, Edgerton, Wis., will be glad to send to interested contractors and engineers.

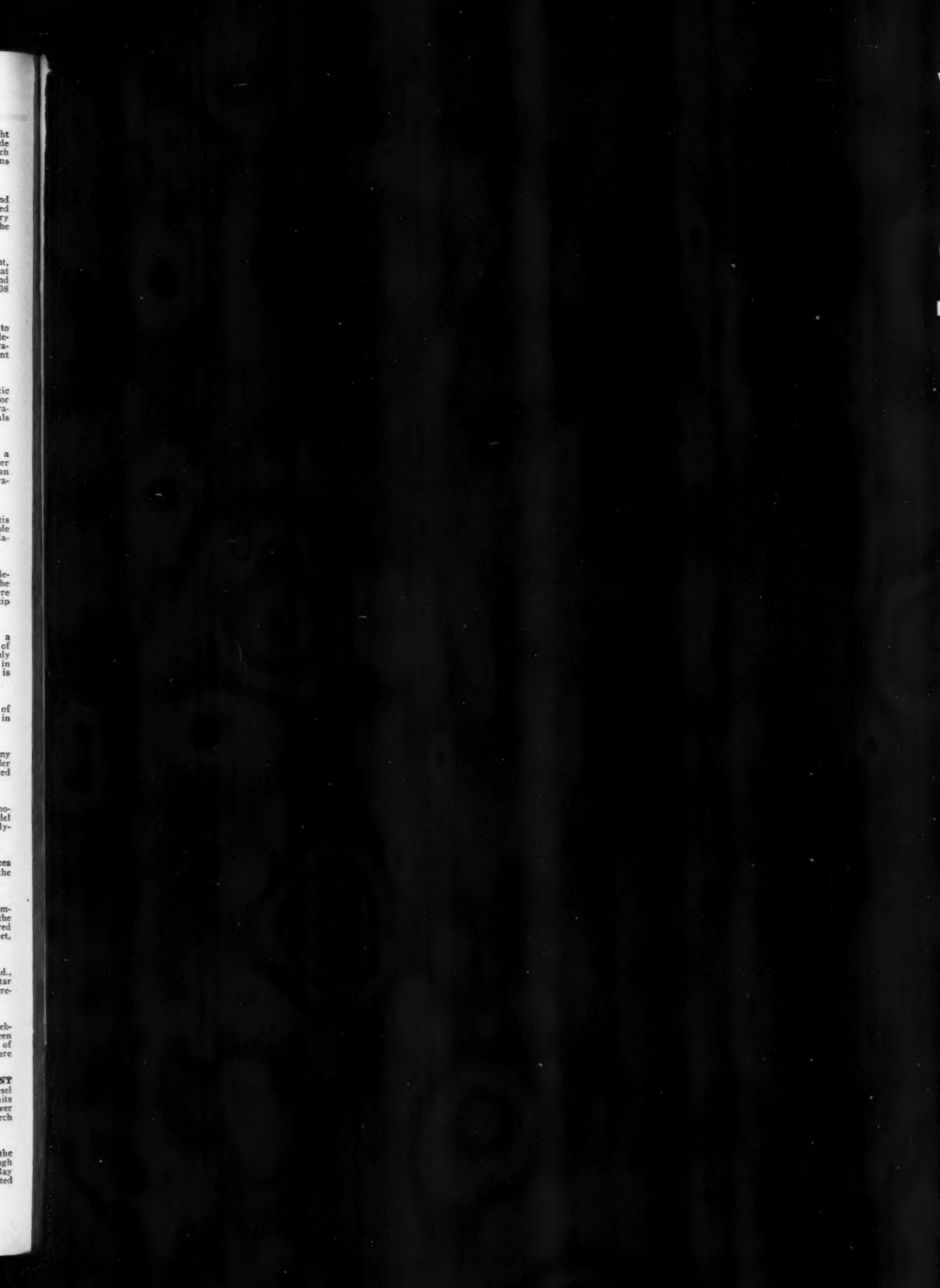
GASOLINE AND DIESEL LOCOMOTIVES
Information regarding the Plymouth line of gasoline and diesel locomotives, complete from the 2-ton to 50-ton sizes, with each size and model a sturdy, rugged, trustworthy power unit, may be obtained from the Plymouth Locomotive Works, The Fate-Root-Heath Co., Plymouth, Ohio.

INDUSTRIAL CLUTCHES IN VARIOUS SIZES
Literature describing industrial clutches that are made in various sizes and of advanced design and construction, may be obtained from the Brown-Lipe Gear Co., Syracuse, N. Y.

A NEW COMPACTED ASPHALT PAVEMENT
Trafficway pavements, the base course of which is compacted by a combined corrugated roller and tamper to furnish a key and bond for the upper course, are completely described in literature which may be secured from the Interlock Paving Asphalt Corporation, 250 West 57th Street, New York.

OIL BURNERS AND PREHEATERS
Bulletin B-200D, issued by the Alexander Milburn Co., Baltimore, Md., describes the Milburn oil burners and preheaters for welding, heating tar kettles, liquids, asphalt heaters and patchers and heating concrete aggregates, for either hand pump or compressed air operation.

FORDSON EQUIPMENT
The W & K sweeper and snow brush which is a year-round unit, Web-steel dual wheels and a fast, flexible crane that replaces as many as fifteen men in the handling of heavy material are among the various pieces of equipment for the Fordson and one-ton truck, described in the literature of Whitehead and Kales Co., Detroit, Mich.

AN AIRLESS INJECTION DIESEL FOR INDUSTRIAL EQUIPMENT
Complete information regarding the new Colo airless injection diesel engine for mobile equipment and stationary service requiring small units and which is built in 1, 2, 3, and 4-cylinder sizes at 8 brake horsepower per cylinder, may be secured from F. van Rossen Hoogendyk, 50 Church Street, New York.

SKIMMERS FOR HARD ROAD WORK
Skimmers that earn bigger profits on hard shallow road cutting for the contractor, and which will cut a perfect grade in a shallow cut through a hard packed stone surface, are described in literature which the Bay City Dredge Works, Bay City, Mich., will be glad to send to interested contractors and engineers.